# The Dock and Harbour Authority

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## Editorial Comments

THE FESTIVAL OF BRITAIN.

On the 3rd of May last, one hundred years after the Great Exhibition in Hyde Park, which, despite initial opposition, eventually proved to be a great success, the King opened the Festival of Britain in London.

The 1951 Exhibition has been designed to advertise to the world the progress made by Great Britain during the past century, and to give an indication of the country's capabilities and potentialities.

In reviewing industrial development, both in this country and abroad, it is at once apparent that the progress made in science and engineering has been immense. In no other century has there been so spectacular a revelation of the secrets of the Universe and advance in general knowledge, much of which has been devoted to "the direction of the great sources of power in nature for the use and convenience of man." It is regrettable, however, that much of the scientific knowledge has been used in ways which have proved to be to the detriment of man and not to his benefit.

In any survey of progress, a prominent place is assured for British scientists and engineers, who have led the world in many fields, not least among which has been the construction of docks and harbours. Here progress, if less spectacular, has been none the less revolutionary, as is apparent when present-day types of design, methods of construction, and the invention and use of modern mechanical equipment are considered.

It is fitting at this time, therefore, to review the changes and improvements which have been effected in the ports of the United Kingdom during the past century, and we are publishing three articles on the subject. The first appears as the leading article in this issue, and we hope the series will prove interesting and informative.

HARBOUR ENGINEERING.

On another page will be found an article by Dr.-Ing. Arved Bolle, the Chief Engineer of the Port of Hamburg. It is infrequently that one has the opportunity of studying German principles and practice of dock and harbour engineering, and while the paper we have been privileged to publish has admittedly been written for students, it nevertheless contains much of interest for the general reader and experienced dock engineer. Indeed, we venture to suggest that they will be impressed with the clear and concise manner in which a considerable amount of information has been presented in so short a form.

It will be remembered that during the past year, space has been given to contributions dealing with quay layout, and portions of the present paper form an interesting addition to the series, particularly in respect to rails and roads, sheds and warehouses.

The author's remarks regarding the use of articulated joints and copper alloy steel sections in the construction of dolphins, and for other maritime purposes, are worthy of note. It is certain that the time will come when the prodigal waste of basic materials used for many industrial purposes, will have to be arrested, and steel being one of those particularly susceptible to oxidation and waste, the technique for rendering it impervious to those agencies must be perfected in order that the employment of a corrosionless steel may become more widely possible.

SHUNTING LOCOMOTIVES FOR DOCK WORK.

The relative suitability of steam and diesel locomotives for general shunting duties on docks, or in industrial yards, has received much attention in recent years, and from time to time we have watched with considerable interest the various claims put forward by the sponsors of the two types, and as early as 1933 a comprehensive article dealing with the relative operating costs appeared in this Journal.

The general concensus of opinion regarding the relative claims seems to be that there is a considerable sphere of application for both steam and diesel shunting locomotives, and that, before making a final decision as to their employment, each case must be fully investigated on its merits.

Advocates of the steam shunting engine have repeatedly pressed for various methods of increasing its very low thermal efficiency at speeds associated with general shunting duties, and the best way of doing so would be by employing a geared steam shunting locomotive operating at higher boiler pressure than that employed on present conventional types, and with a prime mover running at relatively high speed and suitably geared to the driving axles. This increase in efficiency however, would result in higher first cost, and probably would also increase the maintenance cost of boiler repairs.

In 1930, the L.M.S. Railway was experimenting with diesel locomotives for shunting duties, and British Railways are further investigating the matter. More recently, docks undertakings and steel works have placed orders for straight diesel and diesel-electric shunting locomotives and the Port of Bristol Authority has, in the last year or so, placed orders for several diesel engines, some of which are already operating in traffic. Other port authorities are also considering employing diesel engines at their docks.

The chief reasons for this are, firstly, the difficulty at the present time of obtaining suitable skilled boilermaker craftsmen for major boiler overhauls, and the fact that, at present, due to this shortage, the makers themselves are forced to give protracted deliveries for boiler overhauls carried out at their works. Secondly, the unsuitability and poor quality of coal which has often been

## *Editorial Comments—continued*

supplied during the past few years has resulted in an accelerated rate of firebox deterioration.

One cannot of course lay blame for these facts on the steam locomotive. In some applications, such as hauling relatively heavy loads at higher speeds than 10 miles per hour, the steam engine possesses considerable advantages, and there is no doubt that, under certain conditions, there is still a good deal to be said for this type, but the fact remains that industrial shunting is generally carried out at speeds of about 4 to 6 miles per hour, and at these speeds, particularly the former, the diesel engine will, weight for weight, develop considerably higher tractive effort than the steam engine, provided the power of the prime mover and gear ratio are suitably selected.

In view of the requests we have received during recent months for general information regarding the relative running costs, performance, and general design data of steam and diesel shunting locomotives, we have arranged to publish some short articles setting out these features in a simple manner ,and the first of these appears in this issue. The author of the articles, has had more than 25 years' association with locomotive design, and its application to shunting duties, together with long maintenance experience, and is therefore well qualified to write on the subject.

### LONDON DOCK LABOUR ENQUIRY.

Probably more has been written and spoken, during the past thirty years, upon the subject of the dock worker and his trade than upon any other class of labour, but the problem of dock labour restiveness still remains unsolved.

Since 1941, the Dock Labour Scheme has placed the dock worker in an incomparably better position compared with the days of casual labour, and he holds a higher place in the community, more worthy of his industrial importance — a notable change for the better. In spite of this, however, he continues to give the impression to the general public that he is a member of a discontented body of men, ready to strike at a moment's notice and upon any trivial pretext.

On a following page will be found a prècise of the Report of a Committee of Enquiry into unofficial stoppages at the London Docks, which analyses the docker's environment and working conditions and the influence these have upon his outlook, and suggests, among other remedial measures, that greater foresight and supervision are necessary in the industry to prevent circumstances arising which might lead to disputes.

There is no doubt that dockers, especially those of late middle age, are conscious of the past grim history of their calling, and of the fears and uncertainties of casual labour, with its attendant miseries and degradations. Like the miners, they seem to be unable to rid themselves of a sense of victimisation, and that persecution mentality which arises from long periods of privation and social neglect. Such a psychology seems to be the only explanation of the docker's apparent intransigence and proneness to strike, and, on the credit side, gives a reason for his extreme loyalty to friends in adversity. It also lends support to the view that, if dispute conditions can be more or less eliminated, in due course the bad old days will be entirely forgotten.

The causes of disputes, however, have to be sought further afield than on the quay-side. As suggested in the Report referred to above, they may be found in the constitution and work of the Dock Labour Board, which is becoming increasingly regarded by the docker as the employer. The composition of the Transport and General Workers Union also may be considered too vast, and to be covering so many types of workers, that it is unable to keep proper and intimate relations with the dockers. There must be some reason why the men thrust aside the authority of their Union officials, for no one can believe that subversive influences, or some trivial incident, has been the sole cause of the many revolts against the Union, but as the Report shows clearly, these influences are always ready to exploit the workers' loyalty once a strike has been started.

Another problem is the weakness of some aspects of the Dock Labour Scheme, and the suggestion made by the Committee, that disciplinary action should be taken out of the hands of the Dock Labour Board indicates that the present methods leave much to be desired. The chief reason for this is, surely, the dual position of the Union Officials, who are also members of the Board, and so are placed in the invidious position of having to pass judgment upon the very men they represent.

The absence of amenities in the London Docks is one grievance which could, and should, have been dealt with promptly. It is disconcerting to read that there have been " bitter comments from many dock workers on the long delay in the provision of amenities which have been under discussion for many years." The fault, however, cannot be ascribed to one particular side of the industry, and it is unfortunate that, so far, there has been no implementation of recommendations made in 1948 by the National Dock Labour Board, when, at the invitation of the Minister of Labour, they investigated the question of providing additional facilities for dock workers. It is still more regrettable to read in the present Report that, although further representations to the Minister of Labour were made in 1950, the Board were informed that " no further action by the Government was contemplated."

Many of the findings contained in the Report are not peculiar to London, for instances of restrictive practices, unofficial strikes and unrest, have also been prevalent at other ports and have been all too frequent during recent months — the recent disputes at Liverpool, and the present unofficial strike at Manchester docks are cases in point. The Committee's suggestion that " the continuance of unofficial strikes and other unconstitutional action may compel the suspension of the scheme in London " if conditions do not improve, would, in our view, be such a drastic measure that it would place the Scheme in jeopardy throughout the entire country.

There is no doubt that the Dock Labour Scheme has conferred many benefits upon the workers, and no other country has advanced so far in solving the problem of assuring continuity of employment and the abolition of casual labour at the docks. It is to be hoped, therefore, that on their side, the men will honour their obligations, and will realise that disciplinary measures which may be devised to deal with trouble makers, will be for the benefit of themselves and of the industry as a whole. The findings of the Committee of Enquiry merit the close consideration of all who are concerned with Dock Labour, not only in London but elsewhere. We hope, therefore, that steps will be taken to implement the recommendations, wherever they may apply, as there is no doubt that a solution is urgent.

### OIL POLLUTION.

Since the last war, the problem of oil pollution has again come into prominence, due to the increased extent to which oil is used all over the world, and at the instigation of the United Nations Transport and Communications Commission, an investigation into all aspects of the subject is being carried out by the Ministry of Transport of the United Kingdom, and by other countries.

On a following page is printed a specially contributed article which gives details of international legislation already in force and of past attempts which have been made to establish international agreement concerning regulations for the prevention of pollution of sea water by oil. While general concurrence in the light of data already obtained has not been reached as to the extent of its deleterious results, the visible adverse effects are all too apparent at many places around the coasts, while fire hazards in ports have also increased.

The more conclusive studies of the dispersive effects of prevailing currents and winds, and other scientific investigations, which are being made into the question of the effect of oil upon fish breeding grounds, will possibly provide a basis upon which to draw up a Convention.

There seems to be no reason why oil or oily water should, in ordinary circumstances, be discharged into the sea at all. If it is proved that oil adversely affects the harvesting of fish, it is essential, in view of the necessity to conserve rather than waste the world's food supply, that international agreement should be attained upon such remedies as the provision of adequate oil separators, or perhaps chemical treatment on board ship and in port. It may also be desirable to entirely prohibit the discharge of oil or waste into the sea, excepting in an emergency, excluding only those areas where it can be proved that oil would be innocuous in every respect.

# Port Development in the United Kingdom

## Review of a Century of Enterprise and Achievement

By ROGER CHARLES

*" This Festival of Britain has been planned, like its great predecessor, as a visible sign of national achievement and confidence."*

*—H.M. The King.*

THE massive group of statuary at the entrance to the South Bank exhibition epitomises the islanders who, throughout the centuries, have grappled courageously with the problems which have increasingly beset them in their struggle for existence in the islands forming Great Britain.

A thoughtful survey of the past makes it abundantly clear that, whether in the dark days of depression, the overcast atmosphere of war, or the brilliant sunshine of commercial prosperity, as in the Victorian era, the islanders faced problems of increasing magnitude and complexity and, broadly speaking, solved them successfully.

Conveniently condensed in many exhibitions being held throughout the country are examples of the arts and crafts and of the industrial and scientific ingenuity of the British race. Visitors from overseas will be able to gauge from these exhibitions something of the inherent skill and character of men and women of Britain, but of equal importance is the opportunity for these very men and women to see the work of their compatriots and, in gaining knowledge of other people's activities and achievements, to derive much needed confidence in these uncertain days for a renewed onslaught on current problems which, paradoxically, seem to grow more complicated as human skill and knowledge increases.

Development in many fields of human endeavour has been so swift during the last hundred years that the visitors to the Festival of Britain exhibitions will naturally be less susceptible to surprise than were their counterparts in Hyde Park in 1851, yet they have much more to learn owing to the widening scope of world affairs. General knowledge, as opposed to specialised knowledge, is at a relatively low ebb. Particularly is this so in the sphere of the development of the Ports of the United Kingdom.

As an island race, the British would yield to none in their love of the turbulent sea and their admiration of ships and the men who sail them, and much of the history and welfare of these islands has depended upon the courageous and resourceful navigators of past generations. Now, at the commencement of the second half of the twentieth century, the livelihood of the islanders depends more than ever on successful and economic sea transport of food and raw materials. Yet, while fully conscious of this means of transport, many people of Britain, have a very nebulous idea of what happens to the ships when they arrive at or depart from these shores.

It is in the realm of transport that ports must be considered for they lie at the junctions where sea and land carriers meet. Although not a means of transport in themselves, ports are links in the long chain of transport which winds and intertwines all over the world. The Latin root of the word " port " implies a gate through which passes people and goods, but modern ports are by no means as permissively passive as open gates, they assist in no small measure to urge and propel the merchandise onward to its destination.

A cursory glance at history reveals a general pattern in the development of the ports of Great Britain.

In the very early days the ancient kings were the conservators of the rivers, but they usually delegated their duties to a local official, for example, the officer in charge of the Tower of London was responsible for the fisheries and the control of weirs in the River Thames. Then, gradually, the municipalities began to take control, usually obtaining their charters from the reigning monarch in return for services rendered in cash or kind.

Some measure of state intervention was experienced in the Elizabethan era when legal quays were established in all ports in England with the exception of Hull. These quays were appointed, by Royal proclamation, to be used as general landing places during daylight hours owing to difficulties experienced early in Elizabeth's reign in revenue collection, partly owing to congestion in the ports and partly by the use of private landing places for the purpose of avoiding payment of customs duties.

In many ports there then followed a noticeable diminution of the early enterprise of the local authorities. It must be remembered that most of them had held sway in their particular areas for hundreds of years, but either because of the insidious inroads of complacency, or the utter weariness in combating the unremitting onslaughts of wind and tide, many ports fell behind current requirements and siltation was allowed to get the upper hand. The result was that shoaling in the estuaries reduced the effectiveness of navigable channels, in some instances with fatal results to erstwhile flourishing ports.

The next phase occurred when private enterprise left its unmistakable mark in vigorous delineation on the pattern. Private quays were built and docks constructed to meet the ever increasing demand of merchant shipping and overseas trade.

One factor common to most major ports in the country at this time was the remarkable increase of trade which followed the dramatic upsurge of Elizabethan merchant adventuring. This increase in numbers of ships and tonnage of cargo was responsible for the next major alteration in the pattern, as many of the commercial undertakings found it impossible to raise the necessary capital required to keep their undertakings in progressively efficient order. Here the various port trusts stepped in, or alternatively railway companies took control and this design has persisted until now, when, under the Transport Act 1947, a transformation appears to be likely.

This, it must be stressed, is a broad review of the general trend; notable exceptions there were, of course, since it is probably true to say that each port has peculiar requirements not common to the rest, and its administrators have solved their local difficulties by adopting facilities ready to hand.

Much port development took place in the late 18th and early 19th centuries, but a survey from 1851 onwards shows remarkable strides in this field of endeavour. It is not therefore inappropriate in this Festival year to record some of the achievements which took place, and to add to the general knowledge disseminated by the Festival exhibitions some facts on an industry which, while supremely vital to the Nation's well-being, is so much taken for granted.

There are over 300 ports in the United Kingdom and it is thus obvious that detailed examination cannot be given to all within the scope of this review. An individual examination of the major ports and a general survey of important groups of ports will, it is hoped, show sufficient merit in the port administrators to give much satisfaction to the British race as a whole and command the respect of people in other countries.

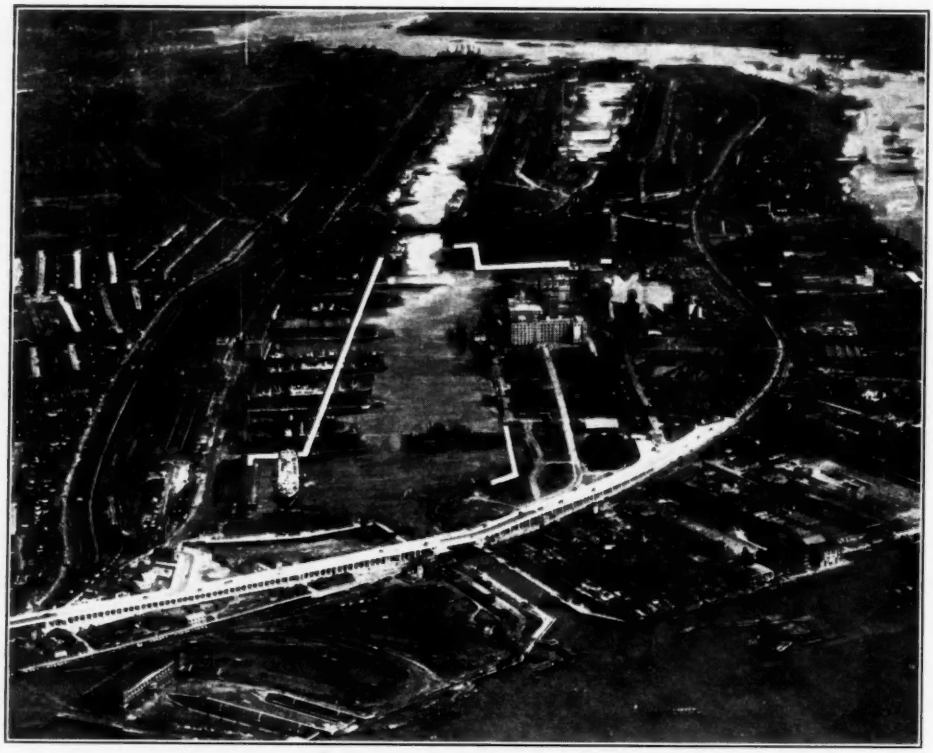
### THE PORT OF LONDON

The story of the Port of London throughout the centuries is one of periodic crises engendered by the exigencies of increasing commerce.

A combination of wartime enterprise and diplomacy brought the port into front rank in Elizabethan times, yet such additional facilities then provided were designed to assist revenue collection rather than improve berthing accommodation and cargo handling. Trade increased, yet port facilities remained virtually static until late in the eighteenth century, when conditions forced merchants and shipowners to agitate for reform.

Pilferage was rife and when the building of enclosed docks was considered, the protection of merchandise ranked equally with the provision of adequate berthing accommodation and improved cargo handling facilities. In 1802 the West India Dock, the first of the

## *Port Development in the United Kingdom—continued*



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The Royal Docks—Port of London—before the modernisation of the Royal Victoria Dock. The white lines indicate outline of new construction work.

enclosed docks, was opened. It was guarded by a high wall and an armed force. Three years later, the London Dock was opened to be followed the next year by the East India Company's docks at Blackwall. The St. Katharine Dock was opened for business in 1828.

Meantime the only group of docks on the south bank of the river was taking shape. The seventeenth century Howland Great Wet dock had been converted in 1806 from its function as a fitting out dock into the Commercial Dock for dealing with vessels from the north of Europe laden with timber, deals, tar, corn and tallow. Shortly after, the Norway Dock was built adjacent to the Commercial Dock. In 1809 a scheme was projected to convert forty-five acres at Rotherhithe (now Lady Dock, part of Lavender and Acorn Ponds) into ponds for storing and bonding timber. The East Country Dock was built soon after and all these docks were acquired in 1850 by the Commercial Dock Company.

Developments had also taken place in the Isle of Dogs, and here it is necessary to retrace the steps of history a little.

The City of London Corporation had obtained powers, under the West India Dock Act 1799, to construct a canal from Limehouse Reach to Blackwall Reach in order that ships, by proceeding along this canal, might save a considerable portion of the time taken to navigate the river round the Isle of Dogs. It was finished in 1805 at a cost of £168,800, but as it proved the reverse of a financial success, it was sold for £12,000 to the West India Dock Company who converted it into the South West India Dock.

At the termination of the monopolies enjoyed by both the East and West India Docks Companies, competition between them ensued which, from a commercial viewpoint, it was prudent to resolve, and in 1838 the Companies amalgamated into the East and West India Docks Company.

This then was the extent of dock facilities in the Port of London when the Great Exhibition of 1851 was opened. The administration was in the hands of the East and West India Docks Company, the London Dock Company, and the Commercial Dock Company, and the conservancy of the River Thames was the duty of the City of London Corporation who had held this responsibility since the 11th century.

The momentum of enclosed dock construction was maintained for some thirty-five years, but administrative changes were in the air, of which the amalgamation of the East and West India Dock Companies and the several small companies at Rotherhithe into the Commercial Dock Company were signs and portents.

The necessity had arisen for docks of a greater capacity than those in being, to accommodate the larger vessels which had come into use. Steamers were establishing themselves as a permanent factor in ocean transport, for after the first steam vessel had appeared in the Thames in 1815, such vessels rapidly increased in number and size. A new company, named the Victoria Dock Company, was formed and in 1855 opened the Victoria Dock at Silvertown. The dock was 94 acres in extent and was designed on a different plan from those of earlier date, the north side having jetties at right angles to the quay, with vaults, transit sheds and warehouses for the handling and storing of perishable goods and other merchandise. The dock was the first in the Port to be connected with the railway system of this country and also the first to be equipped with hydraulic power for working the machinery, two advantages of great importance.

On the south side of the river, at the same time, the Grand Surrey Docks and Canal Company had been formed to acquire the existing docks there and the Surrey Canal which had been constructed in the vicinity. The new company also built the Albion Dock, a deep-water dock of sixteen acres in extent, as well as a new lock entrance, the Surrey Lock, 250 feet long by 50 feet wide, both of which were opened for use on 6th July, 1860.

Competition between the dock companies resulted in the amalgamation of the London and St. Katharine Dock Companies in 1864 when the new concern took over the Victoria Dock. Four years later yet another company built the Millwall Dock, south of the West India Docks, and in 1880, the London and St. Katharine Docks Company opened the Royal Albert Dock for business. This dock, which was the first in London to be lighted by electricity, was intended for use as a transit shed only, no warehouses were provided but single-storey sheds were erected on the quays for the reception of import and export traffic.

The progress of the rival London and St. Katharine Docks Company stirred the East and West India Docks Company into activity and as their own docks showed signs of becoming out of date, they decided on a bold scheme of building docks at Tilbury, a distance of 26 miles below London Bridge. Parliamentary powers were sought and after many vicissitudes the Tilbury Docks were opened in 1886. Fifty-six acres in extent the new docks were entered from a tidal basin of 18 acres. The entrance lock was 700 feet long and 80 feet wide with a depth of 44 feet on the outer sill and 38 feet on the inner sill. Two graving docks were constructed and the whole dock system was connected by rail with London.

This wealth of dock development had naturally affected the conservancy of the river itself and by an Act of Parliament of 1857, the Thames Conservancy was inaugurated to assume sole responsibility for this aspect of the working of the Port from Staines to Yantlet. Thus the City of London Corporation having held sway for over seven centuries had to yield their powers to a new body, on which incidentally they were fully represented, and retained only their duties as Port Health Authority which they still hold.

When the Tilbury Docks were opened, rivalry between the various dock companies became acute and rates were so com-

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petitive as to jeopardise financial reserves to the exclusion of expenditure on maintenance or modernisation.

Then came an echo of the eighteenth century. Merchants and shipowners once more petitioned Parliament to re-organise the Port. A Royal Commission was appointed in 1900 and after prolonged deliberations the Port of London Act, 1908, resulted.

### CREATION OF PORT AUTHORITY

This Act transferred the five groups of docks and the conservancy of the tidal river (from Teddington to the sea—a distance of 69 miles) to a new public trust called " The Port of London Authority " consisting of appointed and elected members representative of all interests in the Port. The new Authority were faced with an onerous task since every aspect of the Port required attention. A comprehensive programme of physical improvements and developments was conceived. It was divided into three priorities. The first embraced urgent works; the second, works which would become necessary given a continuance of the normal growth of trade when the end of the first stage had been reached; the third depended on eventualities.

It was logical to pay immediate attention to the provision of a deep navigable channel to enable the larger ships to reach the docks in safety. Starting at the seaward limit of the Port just eastward of the Great Nore Tower this channel is 1,000 feet wide and 30 feet deep at L.W.O.S.T. and continues up river for 33 miles. From this point westwards it is graduated in width and depth but is more than adequate to enable large sea-going ships to reach the Pool of London. The tidal range of the River Thames is approximately 20 feet.

The building of the King George V. Dock was an early construction work of major importance undertaken by the Authority and is a substantial monument to their enterprise. Opened on 8th July, 1921, by King George V it represents a considerable advance in all respects upon the Royal Albert Dock. The water space is 64 acres in area and the natural depth of 35½ feet below Trinity High Water is increased to 38 feet by means of impounding pumps. The entrance lock from Gallions Reach is 800 feet long by 100 feet wide and it is not always realised that the new R.M.S. *Mauretania* commenced her distinguished career by docking in the King George V Dock on her maiden vovage in 1939.

The north side of the dock is equipped with six sheds of two storeys each, built in pairs, with the top floors extending over each pair. The ground floor of these modern sheds is used for transit of goods and the upper floor as warehouses mainly for tobacco. The south side of the dock is laid out in a novel manner, seven dolphins being placed at a distance of 32 feet from the quay, opposite to each shed. Vessels are berthed at the outside of the dolphins on which the cranes are fixed, and barges are berthed between the dolphins and the quays. This enables discharging and loading operations to proceed simultaneously outside the vessel to barge, between the dolphins and quay into barge, and on to the quay, where two lines of rails facilitate the handling of railway traffic. The dolphins are 520 feet long and 22 feet wide, and the single-storied transit sheds, 528 feet long and 120 feet wide, on the quay are each provided with facilities for dealing with railway traffic at both sides and road traffic at each end in the road-loading-bays.

### IMPROVEMENTS AT TILBURY

Spectacular improvements were carried out at Tilbury. In 1917 the main dock was extended by about 1,450 feet, increasing the water area to 90 acres with a depth of 38 feet, and, in 1921, a river-side cargo jetty was constructed to accommodate vessels bringing only part cargoes to London. Then, in order to meet the needs of larger ships engaged in the Australian and Far Eastern trade, the Port Authority decided to build a new lock entrance. Work commenced in 1926 and in 1929 the new entrance was opened. It is 1,000 feet long, 110 feet wide, and has a depth of 45 feet 6 inches below Trinity High Water on the cills.

Also completed in 1929, the new dry dock at Tilbury was a significant addition to the Port of London's ship repairing facilities. It is 750 feet long, 110 feet wide, with a depth of 37½ feet on the blocks and on the cill. It has been so constructed that it can readily be extended, when necessary, without interference with its use, to a total length of 1,000 feet. The equipment of this dry dock contains some unusual features which are worthy of mention. It includes compressed air plant for the operation of pneumatic tools, cast-steel wedge keel-blocks and mechanically-operated bilge blocks. The dry dock has a clear entrance width of 110 feet and is 133 feet wide at the top altar. Owing to this great width the timber shores, customarily used for supporting a vessel in dry dock, would be unwieldy and unsafe. Hydraulically-operated rising bilge blocks have therefore been installed. These replace shores as well as fixed bilge blocks which would otherwise be necessary to prevent transverse sagging of the vessel. The hydraulic bilge blocks are arranged in pairs, spaced about 30 feet apart, and consist of hinged girders wide enough to take the frames of any vessel and are padded on the upper surface with softwood. One end of the girder is raised or lowered by a sliding roller operated by double-acting hydraulic arms placed beneath the girder which is so shaped that the angle of contact with the roller does not exceed the angle of friction and is therefore self-sustaining.

Coincident with the adoption of the mechanical bilge blocks at Tilbury, an appliance was devised and patented by one of the Authority's engineers to render the entering of vessels into the dry dock and their alignment over the keel-blocks on which they are to rest, a more certain operation than hitherto.

This is accomplished by means of a travelling girder running on rollers laid on each side of the dock and having at its centre a V-notch plumb over the keel-blocks in which the stem of the vessel is held, so that as the girder proceeds up the dock, pushed forward by the vessel, the stem is kept over the keel-blocks. When the vessel is entirely in the dry dock the stern only has to be swung into position. Mounted on the girder at the centre is a petrol engine which is used for driving the girder down the dock as the

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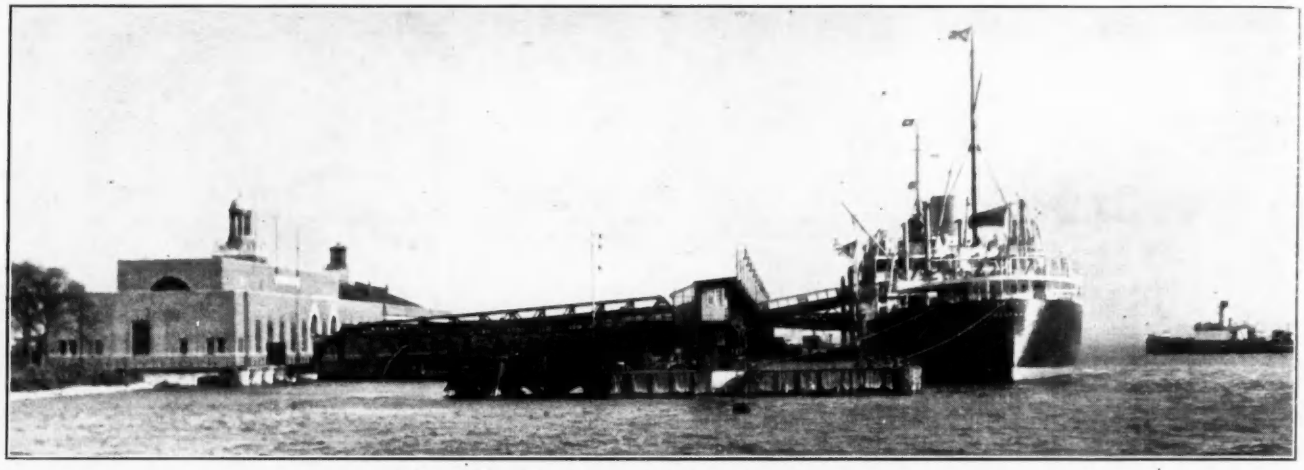
The Royal Docks—Port of London—shewing modernised Royal Victoria Dock in foreground.

## *Port Development in the United Kingdom—continued*



A Royal Mail Lines vessel at Tilbury Landing Stage.

ship is going out. It also enables the girder to be used for lifting the keel-blocks by means of gear attached.

This leading-in girder was damaged during the war and during its repair opportunity was taken to excavate the south end of the dry dock to form a recess for the girder when not in use, with the result that 24 feet have been added to the effective length of the dry dock.

### OCEAN PASSENGER LANDING STAGE

The fifth great improvement work at Tilbury was the construction of the Ocean Passenger Landing Stage which, when opened on 16th May, 1930, removed the reproach against London that no special facilities existed for passengers. The new landing stage, moored in the river abreast of the railway station, can be approached by vessels at all states of the tide, and passengers can be embarked and disembarked from liners completely protected from the weather.

The stage, 1,143 feet long and 80 feet wide, is supported by 63 steel pontoons varying in size from 80 feet by 15 feet by 4 feet 4 inches to 100 feet by 15 feet by 7 feet laid transversely. The pontoons are divided into four watertight compartments and are strung together with 3 feet spaces by five longitudinal steelwork keelsons of box girder section across which are laid steel joists carrying a decking of Jarrah planking.

The stage is held off the shore buildings by four hinged steelwork booms 160 feet long and by timber dolphins at each end. Longitudinally the stage is secured by 3 inch mooring cables laid diagonally shorewards and attached by bridles to bars on large screw moorings. Communication between the stage and the station is established by four covered bridges for foot passengers and one for vehicles.

The end attachments of the booms, the bridge bearings and buttress, are designed for a maximum vertical range of the stage of 29 feet and for a movement of 5 feet longitudinally. The booms are capable of resisting safely a thrust of 250 tons each and at the stage end the universal joint is carried in a sliding crosshead with three stops. The first stop is caculated to shear its bolts at 140 tons, the second at 200 tons and the last at 250 tons, so that the shock of a vessel coming alongside heavily is absorbed gradually. The more important strains arise from this cause and from strong winds; the tidal currents are not more than two or three knots in velocity and are parallel with the stage.

The pontoons have a surplus buoyancy sufficient to take a distributed load of 80 lb. per square foot over the whole stage, the decking being designed for a maximum axle load of 7¼ tons. Two-storey shelters extending for a considerable length of the stage contain at the main deck level accommodation for stage crew, aliens examination officers, etc., whilst the upper floor is used as a landing platform and has continuous sliding sections on the front side.

Baggage is landed on the main deck by ship's gear or chutes and is loaded on to electric trucks for conveyance up the low level bridges to the baggage examination hall, whilst passengers are transferred from the ship by means of two electrically-driven travelling gantries with lifting covered gangways to the upper deck of the shelter and thence by a high level bridge to the baggage hall and station.

The navigation lights, general lighting and heating of the accommodation on the stage are electrical, and a charging station and garage are provided for the electric trucks.

### OTHER FACILITIES AND IMPROVEMENTS

The improvements and additions at Tilbury and the new navigable channel were, however, by no means the extent of the Authority's plan for modernising the Port of London, indeed, all parts of the great undertaking show marked signs of their revitalising policy.

The increase in the growth of the timber trade in London made it imperative for the Port Authority to provide more dock and shed facilities at the Surrey Commercial Docks and in 1922 they commenced the work of building a new dock, the Quebec Dock, on a site formerly occupied by three shallow ponds used for storing baulks of timber in water. This dock, with four new sheds surrounding it, was opened in 1926. It has a water area of 15 acres, a depth of 27 feet, a berthage capacity of five vessels of 400 feet in length, and is connected with the adjoining Canada Dock by a passage of 80 feet wide by 27 feet deep.

Across the river in the Isle of Dogs more comprehensive developments were taking place about the same time.

The West India Docks are very commodious, the depth of water, which is 26 feet in both the Import and Export Docks, deepening to 29 feet in the ship channel, and 29 feet in the South West India Dock, being greater than is usually found in docks of such an age. While the depth is still sufficient for a large proportion of modern ships those vessels have increased considerably in beam. The original entrance to South West India Dock was only 54 feet in width and in 1926 the Port Authority, to remedy this state of affairs, embarked upon the construction of a new entrance lock, 80 feet wide at Trinity High Water level and 584 feet long, on the site of the old lock. Road traffic crosses this lock by an imposing roller-lift bridge. At the same time the Authority decided to cut away certain portions of the quays to provide waterway passages between the Import and Export Docks, between the Export Dock and South West India Dock and between the South West India Dock and the Millwall Dock. Water communications between all docks in this system have facilitated dock working immeasurably, more especially because the larger vessels can now enter the new lock and proceed to any part of the dock system thus bringing these docks into line with modern requirements.

Some years prior to the second world war the Port Authority launched a further scheme of improvements the cost of which was

## *Port Development in the United Kingdom—continued*

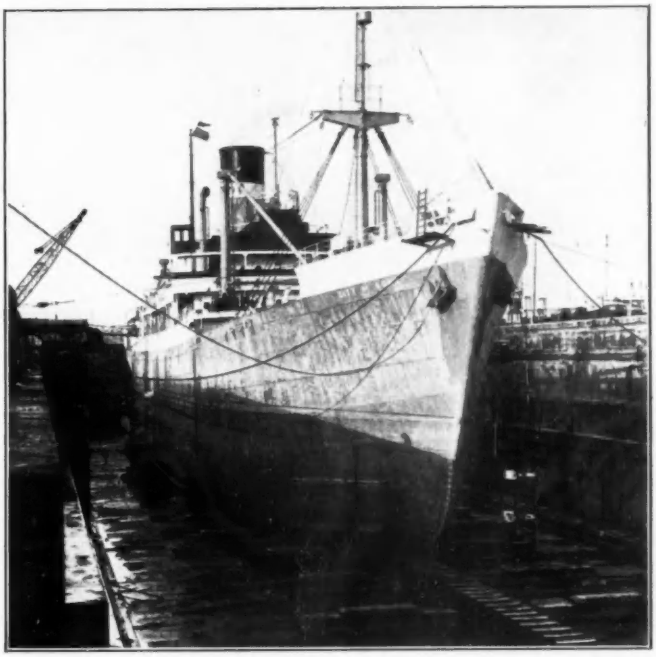
estimated to be £12,000,000. The war checked the greater part of this scheme, but one significant item was carried through to a successful conclusion and that was the entire remodelling of the Royal Victoria Dock. The original timber jetties, set at right angles to the main quay, were demolished and a modern straight deep-water quay built on reclaimed land on the north side of the dock. Five new three-storey warehouses were erected on this quay, and on the south side, three two-storey warehouses were built. In all cases the ground floors of these warehouses are used as transit sheds and the upper floors for storage, the main commodity being tobacco.

Two world wars have, of course, retarded the Authority's plans, and their major task at the moment, is the restoration of facilities destroyed during hostilities.

The successful marriage of science and industry is rarely more evident than in a modern well-equipped port and it is perhaps in the matter of mechanical equipment that the pattern of the Port of London has been most strikingly changed during the last forty years or so. In the early part of the century equipment was scarce, and limited steam and hydraulic plant was regarded as little more than supplementary to ships' gear and almost unlimited manual labour. The P.L.A. were quick to recognise that the growing complexities of modern ship and cargo handling demanded the full employment of labour aiding equipment. Today, electric power, various adaptations of the internal combustion engine, and other forms of applied science have been harnessed to surmount difficulties in port operation. The Authority's problem of post-war mechanisation is more complex than that confronting normal factory management. The dock shed must be ready to receive varying quantities of all types and sizes of parcels of cargo which may be delivered by or to different forms of transport or stored in warehouses according to the merchants' needs. The question is not, therefore, one to be answered by the general use of power-driven belts or overhead runways.

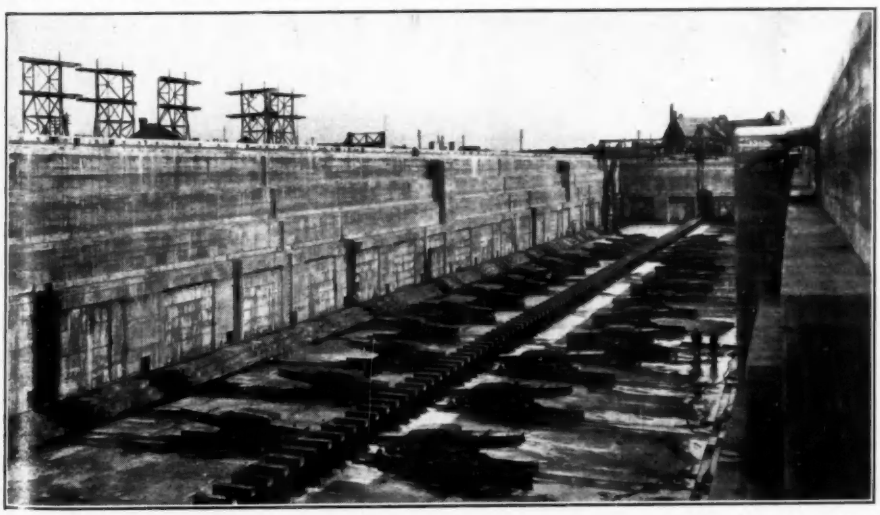
The approach to this problem has been both imaginative and rational. In 1947 a committee of officers was set up to co-ordinate the existing mechanised resources of the Port, to examine units most likely to be of economic use during the coming years and to advise generally on matters affecting the introduction and working of new types of machines. The committee also examines each type of mechanical unit and envisages uses to which it could be put in addition to those in view when purchased.

The magnitude of the Port Authority's task since the second world war ended may be inferred from the fact that their war damage claim was agreed at a figure of approximately £13½ millions, in addition to which there were arrears of maintenance of dredging of the order of some £5 millions. These figures refer only to the property and plant of the Authority and take no account of the vast amount of damage suffered by all the other port installations over the 69 miles of river within the Authority's jurisdiction.



ss *City of Agra* in the new dry dock, Tilbury.

It is not easy to grasp this immense picture of ships coming and going, cargoes being handled, and dockland reconstruction and development work, for the size and configuration of the Port of London tend to defeat the visitor. Facilities exist, however, whereby at least representative sections of the Port may be visited with comparative ease. During the summer season the P.L.A. organises public cruises on three afternoons each week from Tower Pier, through the industrial reaches of the Thames and into the Royal Docks. Private passenger launches, including the Thames waterbuses, make frequent voyages through the middle reaches. In this connection the P.L.A. has recently built new piers for these services at Putney, Charing Cross, Blackfriars and have reinstated Old Swan Pier near London Bridge. Other passenger launches are available to take visitors through the rural beauties of the upper reaches. Here again the P.L.A. has been mindful of the needs of passengers by reconstructing the Richmond Landing Stage. These waterborne services will rightly play no little part in entertaining visitors to the Festival of Britain, for the Thames, a significant feature in 1851 no less than in 1951, and a magnificent backcloth to the modern Exhibition, is an integral part of Britain's story, both reflecting and inspiring so much of London's mellow charm, infinite variety and unchallengeable strength.



New Dry Dock, Tilbury, shewing hydraulic bilge blocks. The leading-in girder is at far end of the dock.

In a short survey of this nature, it is difficult to do justice to the growth of this great port, the trade of which is, in reality, a reflection of that of the British nation. It is hoped, however, that sufficient has been written to show that, in spite of difficulty and frustation, the Port of London has a record of achievement of which its administrators can be justly proud.

The story of British ports generally is no less impressive, and in the next article the history and development of Liverpool, Bristol and the Clyde ports will be discussed.

# Turnround of Ships in Port

## Design of Vessels an Important Feature

By PATRICK R. DARWIN

Much discussion has taken place in recent months concerning the necessity for quicker turnround of ships in port. That speedy turnround in port is a great advantage to the shipower cannot be doubted, and it has become an important aspect of the development of cargo handling and dock facilities.

It appears, however, that the majority of suggestions which aim at reducing the time spent by ships in dock, concern improvements to shore plants, and tend to neglect that aspect of the problem affecting the ships themselves, and their crews. It is obviously futile to provide costly and extensive methods of dealing with a cargo in a few hours if the ship in question is not ready to sail immediately loading operations are complete, or if, on the other hand, a cargo is not to be ready at her next port of loading.

At the majority of British ports, tides limit the times at which ships may enter and leave cargo docks, and in some cases the rivers and canals leading to such docks. In this respect, the question of ships' crews is important, especially in vessels engaged upon the coasting and short sea trading services. To mention a typical case, let us examine that of the Thames Up-River Collier carrying coal from the North East Ports to Power Stations located on the upper reaches of the tidal Thames. Loading plants in the North are capable, provided the necessary coal is instantly available, of loading these vessels with a full cargo of 2,600 tons of coal in sufficient time to allow the vessel to sail on the tide immediately following that upon which she docked. At her London terminus, grabs are used to discharge the coal, and the time spent alongside is again kept to the minimum of a single tide. The navigation of the London River involves the negotiation of a large number of Thames Bridges, a consideration which demands very careful timing in order to coincide the ship's draught with the altering state of the tide and headroom under the arches, both during the incoming and outgoing passages. If the ship misses the third tide after leaving the loading port she is delayed for twelve hours, and this only has to happen three times before she loses a round trip altogether.

Including an Annual survey and overhaul in drydock these vessels make between sixty and seventy such voyages in one year. Notwithstanding the provision of modern navigational equipment, a higher power/engine weight ratio enabling ships to travel faster for the same machinery weight and less space for engines and fuel, it must be remembered that with vessels of this class it is an easy matter for a ship to be delayed due to faulty handling at sea, during navigation of harbour approaches, or in dock, and a very few minutes make all the difference between catching the tide and missing it. If coasting seamen can be kept permanently employed in the same ship, it follows that the efficiency of handling will improve. It is recognised that a new man aboard a ship takes time to become accustomed to her peculiarities, but once he is acquainted with the way the ship and her gear should be handled, he is able to carry out his work quickly and efficiently.

A ship which spends only a few hours in dock at each end of her run requires a full complement almost constantly, even in dock. This allows but little shoregoing time to the men, and, if their homes are not in the immediate vicinity of the dock area at one end or the other, their time at home amounts to practically nothing.

The coasting trade, therefore, is not attractive to the bulk of British Merchant seamen, and yet it is the one whose demand for regular and permanent crews exceeds that of any other kind of Mercantile trade. Unless the standard of accommodation on coasters is high, difficulty is found in obtaining crews in the first place, but shipboard conditions must be equal to those of deep-sea vessels if seamen are to be retained permanently. This necessity demands great ingenuity on the part of the ship designer, but the problem must be faced, and the majority of coasting shipowners are specifying single berth cabins for each member of the crew, and other arrangements for their comfort.

In the case of vessels engaged upon a regular run between two districts, it is generally found advisable to sign half the crew from one end of the service, and the remainder from the other. This facilitates the convenient arrangement of leave ashore, as part of the crew are always required aboard for incidental work such as changing berth and handling hatch covers, etc.

Speed at sea is, of course, just as important to the shipowner as quick turnround in port. Very fast ships, however, can in many cases be quite as uneconomical as very slow ones, and the owner must decide upon the maximum power he can afford when viewed in conjunction with demands upon space for machinery and fuel, with cost and maintenace, and other considerations of the particular run for which the vessel is required. The important point is to make the utmost use of the power and subsequent speed once this has been decided upon.

It is not easy to compare types of machinery with regard to their effect upon " delayed hours " incurred during any period of time, but ease and speed of maintenance are great advantages in reducing this wasted time. If any particular case can be specifically mentioned as having greater advantages than any other, it should be that of the Diesel Electric Installation. The use of, say, four small engines in place of one large one facilitates the complete removal of one unit for repairs, especially as they are not mechanically connected to any shaft other than those of the generators, which may be moved as component parts of the complete sets, each unit being seated on resilent three-point mountings. The owners of diesel electric ships have even found it economical to keep a complete unit ashore which can be used to replace a defective set, which, in its turn, may be removed, repaired and overhauled, and then placed in reserve for the next emergency. A loss in speed of only 10 per cent. results when one out of four sets fails at sea.

The use of the variable-pitch propeller has been introduced in up-river colliers to ensure minimum delay when the necessity arises for emergency manœuvring in a congested channel. This type of propeller eliminates reversing gear on the main engine, and also ensures a very small engine speed range for all forward and reverse speeds of the screw.

The installation of radar appears to be general practice for almost all new building tonnage and a considerable number of ships of all kinds already in service have been fitted with radar. This is another part of the vessel's equipment which can effect a great saving in time during foggy weather conditions, allowing ships to make port in comparative safety at speeds not far below normal. It has also been known on occasions for ships in dock to use their radar sets to guide other vessels into dock who are not so equipped, using wireless or telephone in conjunction.

### MODERN HATCHCOVERS

A very advantageous solution to the hatchcover problem has been developed since the war. Previously much time and energy was wasted preparing the ship to unload or receive cargo, and more time was wasted battening the hatches before the ship could leave for sea. The satisfactory development of the patent steel sliding hatch cover has eliminated the use of individual handling of covers, and tarpaulins are no longer required. The covers can be stowed at one end of the hatch in a very small space, in a matter of a few minutes, the entire procedure being undertaken mechanically by the anchor windlass or by a small winch provided for the purpose. When cargo-loading operations are complete, the single pull is reversed and the hatches quickly restored to their seagoing position. The MacGregor type are common, in fact almost universal, in modern colliers, and a similar pattern has been developed for the weather decks and all lower decks of ocean-going ships. Other types of steel covers, such as the hinging flap type stowing against the mast at each end of the hatchway are also used extensively, and the development of steel covers is now being carried forward, and even more efficient methods are likely to appear in the future.

Because of the nature of their work, it is, perhaps, necessary to concentrate upon coasters and the conditions of the coasting trade, as far as the " ship " side of quick turnround in port is concerned. But it follows that a large cargo liner takes much longer to work cargo in dock and there is, therefore, more scope for the reduction of this time, although the percentage reduction as compared with

## *Turnround of Ships in Port—continued*

coasters should be equivalent. Colliers are generally dependent upon shore plants for loading and discharging of cargo, thus it follows that modifications in design to the ends of quicker and more numerous round voyages must be largely confined to developments regarding crew, speed and efficiency of machinery, and the running and handling of the ship in all respects which influence her earning capacity. General cargo coasters may be considered with larger cargo vessels in that they should have limited means of handling their own cargo, without having to rely on shore plants.

### SPECIAL CONTAINER SHIPS

An interesting new general cargo coasting system in Scandinavia has been introduced recently. The Danish container ships "Riberhus" and "Axelhus," built for Copenhagen owners, are specially constructed to carry their cargo (about 600 tons) in containers which are loaded directly into the hold, thus reducing the extent and cost of cargo handling and the danger of theft. The ships maintain a regular cargo service between Copenhagen, Horsens and Vejle, and the unusual features incorporated in their design have, again, been called for by the necessity for reduction of delay in port and the subsequently larger number of round voyages per year.

There are two complete decks, all superstructure and the diesel machinery being located aft, in accordance with the latest trend in design of general layout, which is beginning to affect ships of far greater size. There is a single hatch over ninety feet long, fitted with steel hatch covers, the two centre sections of which are enlarged and strengthened to form the base of two electric deck cranes. The reminder in small sections—are stowed in much the same way as are the patent covers fitted to colliers, except that the power is provided by the cranes which move apart towards the hatch ends, pushing the covers before them. They tilt and stow themselves when they reach the hatch end, and the cranes are free to return to duty wherever they may be needed. The cranes are provided with five electric motors to facilitate fore and aft travel (using two of the motors), luffing, slewing and hoisting, simultaneously.

The tween deck hatch is of the same length as that on the weather deck, and is fitted with covers which are flush with the surrounding deck. This allows the use of fork-lift trucks which are used to stow the containers in parts of the tween deck and hold not readily accessible by the cranes.

The shipper packs his cargo into the containers or crates which are transported to the dock by road, they are lifted aboard and stowed by the ship's gear, and are unloaded similarly. Shore cargo-handling gear is freed for use with other ships, and a single working day in Copenhagen, and about three hours at each end of the other ports is the total extent of time spent in dock during each round trip. The speed of the vessels, fifteen knots in service, permits three sailings per week from Copenhagen.

These ships leave very little to be desired as far as economy, speed and efficiency are concerned, both in port handling cargo, and at sea, and may well provide an example for continued development along similar lines.

### MECHANICAL HANDLING GEAR

The use of mobile gear in ships' holds is an aspect of cargo handling which justifies careful investigation. Owners frequently complain of damage caused by stevedores to frames, bulkheads, grainboard uprights, hold ladders, etc., by the fixing of hauling gear to such steelwork and causing distortion while cargo is being brought underneath the hatchways. The use of fork-lift trucks, overhead lifting gear arranged to slide along rails fitted below beams, trolleys and bogeys, would do much to eliminate such damage, and the use of rollers built into the deck and hold ceiling has even been suggested. The trimming of bulk cargo such as bauxite ore also invites the use of small bulldozers in the hold, which could even been accommodated in small compartments on the ship for use at the discharging port. Trimming could thus be undertaken cheaply and quickly, reducing cargo handling time and expenditure.

As far as tankers and bulk oil and petroleum carriers are concerned, any discussion regarding the size and capacity of cargo pumps must be compared with similar considerations regarding main propulsion machinery, as space and cost are involved. It is, of course, obvious that large pumps on the tanker can deal with a full cargo quickly and allow the vessel to return to sea after a minimum period in dock. It is for the owner to decide to what extent the advantages of powerful machinery for all purposes will offset the initial cost and subsequent maintenance, and also the demands for space which must be deducted from the cargo cubic capacity. The balance varies for every trade, and the nearer the owner approaches the ideal balance for his particular run, the more economical his ships will be.

The development of usual deck gear need hardly be mentioned. Ship designers are to-day being called upon to pay particular attention to the layout of derricks and winches to the ends of efficiency, convenience and economy of cargo handling, and the range of deck machinery as far as winches, deck cranes and other items are concerned is well nigh removing the limits to which an owner may go when arranging the cargo handling facilities for a new ship. In addition, recent developments in engine room auxiliary power (for example:—modifications to diesel generators to burn heavy fuel) and a larger range of sets available for shipboard use, have made it economical to provide electric deck machinery of greater power, a factor which allows heavier lifts to be handled at greater speeds.

An important tendency in ship design as affecting cargo handling in dock, is the increasing popularity of the specialist ship. The majority of ships constructed to-day are built specially for the kind of run upon which they are to be engaged, which generally implies that she is designed for maximum efficiency as far as some particular cargo is concerned. For example, ships of the timber and esparto grass trades are usually built with long, clear decks for deck cargo, and vessels built for the carriage of bulk cargoes handled by grabs, or for large unit items such as railway carriages, have holds with as few pillar and obstructions as possible. Tankers and colliers are also arranged specifically for their type of trade.

The greater the extent to which ships are specially designed for their particular services and cargoes, the greater will be the consequent ease and speed of turnround in port.

In conclusion, let it be said that as far as Great Britain, or, for that matter, any country depending upon imported goods for food and materials, is concerned, the price of such goods when they become available to the individual, will depend to a large extent upon the cost of importing such goods. This involves an International aspect of economy which does not directly concern us in this article, but which is, nevertheless, a vital one. The minimising of such shipping costs depend for the greater part on owners' policy, but speed at sea, and, even more important, in port, are the factors which influence the position most strongly. It becomes obvious, therefore, that the question of cargo handling and turnround of ships is not merely a matter of convenience and profit for the owner, but one which affects the fortune of Britain's entire economical and commercial system.

## British Standards Exhibition

This year the British Standards movement attains its Golden Jubilee, and as a part of the celebrations, an Exhibition supported by practically the whole range of British industry will be held at the Science Museum, South Kensington, during the two weeks beginning 18th June, 1951.

As Britain was the first country to put industrial standardization on an organized basis nationally through the British Standards Institution, it is fitting that the first exhibition devoted to this subject should be staged in London—and during the national Festival year.

The Exhibition will show how research at one end of the production chain and quality control at the other are linked with and helped by standardization. Other special features will include apparatus used in testing for compliance with British Standards.

The Exhibition will be opened at 11.30 a.m. on 18th June by the President of the Board of Trade. Admission will be free, and opening hours will be 10 a.m.—7 p.m. each day (except Sunday) from 18th to 28th June inclusive.

# Correspondence

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

## SCALES FOR MOVING BED RIVER MODELS

The above article by Professor T. Blench which was printed in your issue of March, 1951 raises a number of interesting points.

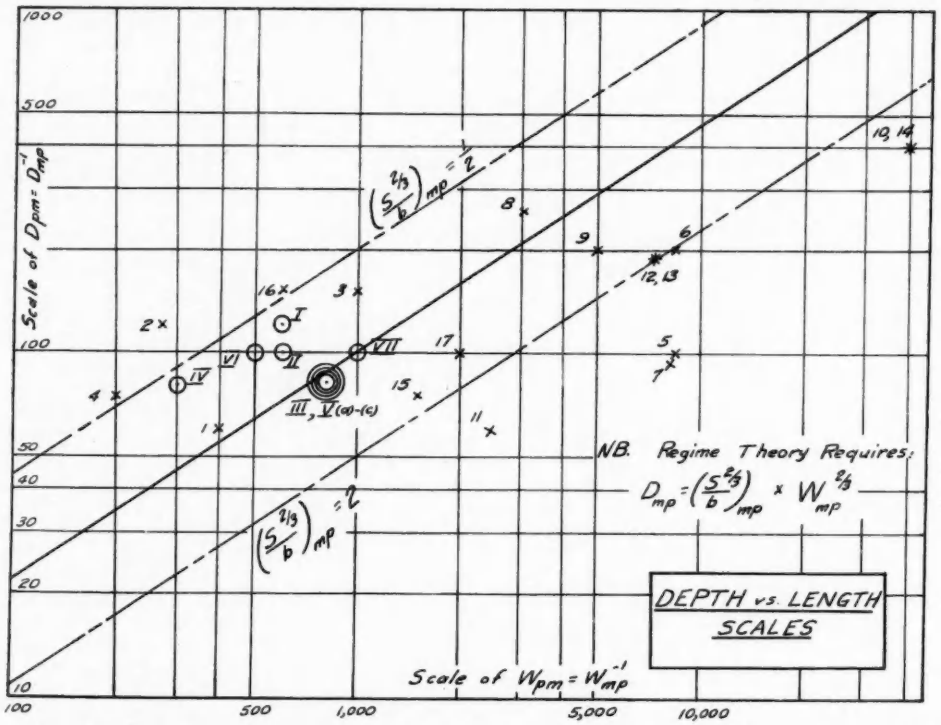
The use of the regime theory in deciding the scales of models was developed originally from observations made on canals and river systems in regime, in alluvial plains. Care should be exercised before applying it to other cases of this nature. Tidal regions, in particular are often very complex, and the area covered by a model may include several branched channels running through a variety of different bed materials.

From first-hand experience of two of the models mentioned in the article, those of Penang and the river Prai, it is pointed out that the area concerned is not just an estuary, but a sea-strait between Penang Island and the mainland of Malaya. (The main current reproduced in the model is a tidal stream running parallel to the mainland, which is not directly dependent on the local rise and fall of water. The river Prai discharges into the sea-strait from the mainland, and behaves as a normal small tidal river. The Silt accumulating in the river mouth is not brought down the river, but is carried by the littoral currents, and enters the river on the flood tide. It is, therefore, hardly surprising that the natural bed material varies from gravel banks in some places to fine non-cohesive mud in others.) The area under study is far removed from a reasonably straight river or estuary running through an alluvial plain. It may well be that some other tidal models mentioned in the article have similar objections.

Particle size, shape and density has a large bearing on the bed-factor in particular, so that a model in which the natural bed material is not used should not be directly compared with the regime theory. (The Penang and River Prai models were not intended to operate with the natural bed materials.) It would be useful, therefore, if a list of bed materials was included in the table of models and scales.

In the Penang model, a coarse pumice, of mean specific gravity 1.7 was used, whilst in the Prai model, pumice represented the coarser materials found in nature, with a range of much lighter particles to represent the silt. In both models the particles were quite large, passing 20 mesh and resting on 28 mesh. Both models worked well with lighter and coarser particles than in nature. According to the regime theory the vertical scale was too great in the Penang model. In the case of the Prai model the time and velocity scales were quite different from the conventional scales, and were chosen to suit the bed material employed, so that a strict comparison with the regime theory is not possible.

Two models were constructed recently in this country to scales in very close accord with the regime theory. These were the models of the rivers Wyre and Forth, operated by the Hydraulics Research Organisation of the D.S.I.R., and reported in your journal in May 1950. The model of the Forth, horizontal scale 1:1800 and vertical scale 1:144, did not reproduce current bed movement, due, apparently, to the flow not being turbulent. As further evidence of this, the bed had to be artificially roughened with pebbles in order to make it reproduce the correct flow. The model of the river Wyre, horizontal scale 1:1000 and vertical 1:100, did not reproduce the natural degree of movement, and experiments with lighter materials were being considered. Further details of these models, shewing in which respects their design differed from regime theory, if at all, would be most instructive.




TABLE

| Point | Location of Prototype | W pm. | D pm. | Bed Material in Model | Remarks |
|---|---|---|---|---|---|
| 18 | Scheldt-near Termonade | 150 | 50 | Pumice | |
| 19 | Tigris | 250 | 60 | Natural sand Clay banks | |
| 20 | Ohio | 720 | 72 | Sand about ½rd natural dia | Not run to conventional discharge scale |
| 21 | Rhone-Barrage dela Mulatiere | 250 | 50 | Sand | Sand not from river |
| 22 | Rhone-Edouard Heniot Dock at Lyons | 150 | 50 | Pumice | |
| 23 | Mississippi-Brook Point | 1000 | 125 | Sand | |
| 24 | Mississippi-Point Pleasant | 1000 | 125 | | Slope distortion of model to ensure proper bed movement |

It is probable that a further criterion involving the Reynolds Number will have to be used, on the lines suggested by Professor Allen in his book " Hydraulic Models." More information is also needed about the effect of exaggerated slopes in models. The theory must be modified to some extent where the slopes approach the angle of repose of the natural material.

In order to assess the real value of the regime theory a table should be compiled similar to Fig. 1 of Mr. Blench's article (reproduced above) consisting of models of canals and non-tidal rivers which are known to have reproduced nature closely. The bed material used should be stated. The table (see above) gives a short list of such models, the information coming mainly from Professor Allen's book. A glance at the Bed Material and Remarks columns will shew the diversity of method existing today.

Comparisons of different models with each other, and with any given set of laws, are thus made very difficult. At the same time, this diversity of method emphasizes the need for a consistent theory such as the regime theory, which if properly applied would be an invaluable tool for the model engineer.

Yours faithfully,

D. M. McDOWELL.

17, Skelwith Road,
London, W.6.
16th May, 1951.

# Locomotives for Heavy Dock Shunting

## Comparative Running Costs of Steam and Diesel Engines

By A. O. HELPS, A.M.I.Mech.E., M.I.Struct.E.
Chief Assistant Engineer (Mechanical) Port of Bristol Authority.

During the past few years the employment of the straight diesel shunting locomotive in docks, steelworks and railway yards has considerably increased. In 1949 the Port of Bristol Authority ordered four 300 b.h.p. and three 200 b.h.p. straight diesel engines for general dock shunting duties, and under Mr. N. A. Matheson, M.I.C.E., A.M.I.Mech.E (the Engineer-in-Chief of the Port of Bristol Authority), the writer has investigated the economic and mechanical considerations of their employment.

Railway operations at the Royal Edward, Avonmouth and Portishead Docks are carried out by the Port Authority which at present operates and maintains twenty-three steam locomotives, ranging from 16,000 lbs. to 11,000 lbs. tractive effort.

In the " Dock and Harbour Authority " for September, 1933 the writer contributed a paper giving a very considerable amount of technical detail on the comparison of steam and diesel engines for industrial shunting purposes. Boiler efficiencies and steam consumption etc., and fuel consumption, together with relative tractive efforts of the two types, were fully dealt with, and it was clearly demonstrated that whilst the relative cost per annum of fuel oil for the diesel locomotive and coal for the steam locomotive were of paramount importance, other factors had to be taken into account before the relative overall running costs coud be conclusively ascertained.

In this article it is not intended to again go deeply into the technical aspect of the subject, but rather to bring up to date the main conclusions of the previous paper, and in addition to give general particulars of recently constructed diesel shunting locomotives.

The employment of this type of locomotive for docks or other industrial shunting appears at first sight to be suitable in every respect as stand-by fuel and preparation time (steam raising, etc.) is eliminated. There is, however, a very great difference in the first cost of steam and diesel types of equal tractive effort, and in the case of locomotives of say 200 b.h.p. and 300 b.h.p. the ratio of cost is, approximately 2 to 1 in favour of the steam locomotive, and it is often found after thorough analysis of the required duty that the mean load factor is so low that economies gained in running costs by the diesel locomotive are offset by its higher interest and depreciation charges. It should be clearly understood that there is no hard and fast rule in this matter but that each case must be considered on its particular merits.

Since the earlier paper referred to above, considerable advance has been made in the diesel type of prime movers fitted to locomotives, and the transmission gears etc., have also been simplified, and considerably stiffened up to perform satisfactorily the very arduous duties encountered, and the incorporation of the fluid coupling in the transmission has had a great influence in this respect. The writer personally favours the inclusion of this device in any straight diesel locomotive employed on shunting duty. It is appreciated that the locomotive may be slightly slower in overall performance, but this slight disadvantage is more than offset by advantages gained in other respects and resulting in more trouble-free running.

There is no doubt that under favourable conditions economic advantage can be obtained from diesel locomotives of these powers in industrial service, provided that operation and servicing is planned and supervised with proper understanding

For consideration of the economic position let us assume we are considering the relative merits of a 300 b.h.p. straight diesel engine and the comparative 18-in. steam engine. The tractive effort of both these types at 4 miles per hour would be approximately 22,000 to 24,000 pounds. The approximate present day prices would be:

300 b.h.p. straight diesel locomotive £16,500
18-in. steam locomotive ... ... £8,000

Now it is at once obvious that in order to offset the Interest and Depreciation charges on the very much more expensive diesel locomotive it must possess very considerable advantages in other respects, and it will be found on analysis that the main saving effected by the diesel locomotive is in the fuel cost per annum,

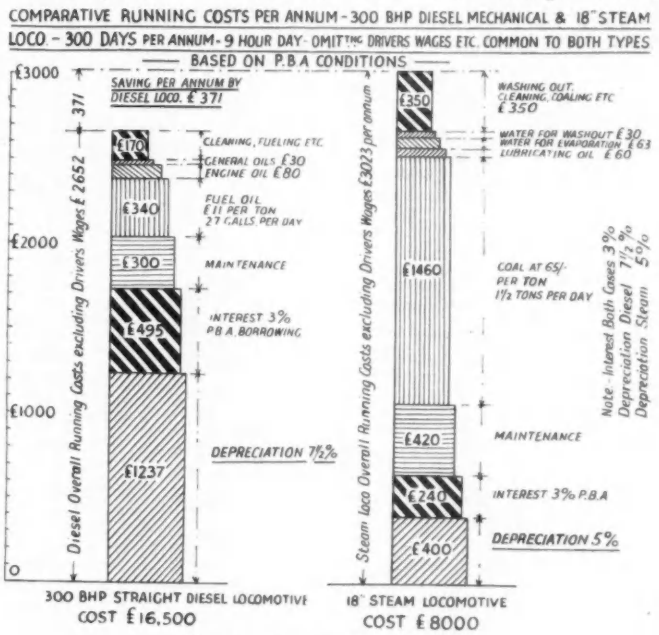

COMPARATIVE RUNNING COSTS PER ANNUM - 300 BHP DIESEL MECHANICAL & 18" STEAM LOCO - 300 DAYS PER ANNUM - 9 HOUR DAY - OMITTING DRIVERS WAGES ETC. COMMON TO BOTH TYPES
BASED ON P.B.A CONDITIONS
£3000
£2000
£1000
0
SAVING PER ANNUM BY DIESEL LOCO. £371
371
Diesel Overall Running Costs excluding Drivers Wages £2652
£170
CLEANING, FUELING ETC.
GENERAL OILS £30
ENGINE OIL £80
£340
FUEL OIL £11 PER TON 27 GALLS PER DAY
£300
MAINTENANCE
£495
INTEREST 3% P.B.A. BORROWING
£1237
DEPRECIATION 7½%
300 BHP STRAIGHT DIESEL LOCOMOTIVE COST £16,500
Steam loco Overall Running Costs excluding Drivers Wages £3023 per annum
£350
WASHING OUT, CLEANING, COALING ETC £350
WATER FOR WASHOUT £30
WATER FOR EVAPORATION £63
LUBRICATING OIL £60
£1460
COAL AT 6S/- PER TON 1½ TONS PER DAY
£420
MAINTENANCE
£240
INTEREST 3% P.B.A
£400
DEPRECIATION 5%
Note: Interest Both Cases 3%
Depreciation Diesel 7½ %
Depreciation Steam 5%
18" STEAM LOCOMOTIVE COST £8000

Fig. 1. Running Cost Graphs.

which means that the diesel locomotive must be used with as high a load factor as possible in order to use enough fuel to save enough money to offset its higher Interest and Depreciation charges.

The writer, together with others, has estimated that in order to justify its employment the diesel locomotive must be worked 2,500 to 3,000 hours per annum, and in the particular case under consideration it is estimated the locomotives will work 300 days per annum on a 9-hour day basis.

Giving 2,700 hours worked per annum, Interest and Depreciation Rates have to be very carefully considered, and in this investigation an annual cost graph (Fig. 1) has been prepared. Figure 1 is based on:

(a) Cost of 300 b.h.p. diesel locomotive ... ... £16,500, Interest 3%, Depreciation 7½%

(b) Cost of 18-in. steam locomotive ... ... £8,000, Interest 3%, Depreciation 5%

A slight difference in the Depreciation Rates assumed considerably affects the conclusion arrived at with regard to the annual saving by the diesel locomotive, for example if Depreciation of the steam engine is reckoned at 7½% a saving of £571 per annum would be indicated.

It is considered that the annual overall saving shewn by Fig. 1, viz. £371 per annum in favour of the diesel locomotive, is the more probable figure.

## *Locomotives for Heavy Dock Shunting—continued*

The proof of any investigation of this nature is only obtained by actual trial over a protracted period, but very careful investigations have been made and results in practice should not be far different from those estimated. Relative costs have, from time to time appeared in the various engineering periodicals and are in close agreement with the figures given in this paper.

Both graphs give full particulars of annual expenditure under the conditions stated. In dock working it is generally conceded that the second man on the locomotive footplate cannot be dispensed with, and in both examples worked out the driver and mate's salaries have been omitted as they are common to both types of locomotives. If in some cases under consideration the second man on the diesel locomotive can be dispensed with, a further saving can be credited to the diesel locomotive.

Again, if the locomotives are working say two 8-hour shifts a day, the saving by the diesel locomotive will be very considerably increased due to more fuel being used, and under this condition the diesel locomotive would be more advantageously exploiting its main source of saving and consequently further offset its high Interest and Depreciation charges.

The conclusion therefore reached is that by the employment of the 300 b.h.p. diesel instead of the 18-in. steam locomotive an annual saving of approximately £371 can be effected.

From the cost graphs it will be immediately appreciated that the bulk of this saving is effected by the lower annual cost of fuel for the diesel locomotive; actually the fuel for the diesel costs only about one-quarter of the cost of the coal for the steam locomotive, and under the conditions assumed in the finally accepted example the higher Interest and Depreciation rates on the diesel locomotive are more than offset by the savings in fuel costs resulting from its employment. On the final basis taken, viz., Fig. 1:

Difference in Interest and Depreciation = £1,092

Difference in Fuel Costs ... ... = £1,120

In addition to the very large saving in fuel costs by the diesel locomotive there are other smaller savings in favour of the diesel locomotive but fuel constitutes the main saving. It is, however, not only the present price of fuel which should receive attention, but also its potential future price, should diesel locomotive traction become more general, and this point should not be lost sight of.

Since preparing the cost graphs for this article, slight increases in the price of both fuel oil and coal have taken place but this will not greatly affect the general conclusions arrived at.

The most difficult problem of steam locomotive maintenance is undoubtedly the boiler repair work required, and this of recent years has been considerably increased by the quality of coal often supplied. Generally speaking difficulty is experienced in obtaining suitable boilermaker craftsmen to carry out the high class of work required on boiler repair work of a maior nature, and one can envisage this difficulty increasing in future. During the writer's visits to various locomotive manufacturers' works in the last year or two, they have all informed him that they are severely handicapped owing to the lack of skilled boilermakers, and there is no doubt that in many repair shops protracted delays have occurred through shortage of boilermakers, and locomotives have been out of service for long periods as a result.

The sole fact militating against the more general employment of the diesel locomotive (particularly at low load factor) is its high first cost with consequent heavy interest and depreciation charges; but with standardisation, and increased demand met on mass production lines, there is no reason why the first cost cannot be reduced and if this is accomplished there is no doubt the diesel locomotive will be come an even more serious competitor of the steam locomotive in all forms of traction duty.

DOCK OR INDUSTRIAL SHUNTING DUTIES — TABLES GIVING CYLINDER BORE OF STEAM LOCOMOTIVE OR BHP OF COMPARATIVE STRAIGHT DIESEL SHUNTING LOCOMOTIVE REQD.

| GENERAL INFORMATION | CONDITION UNDER WHICH TRAIN IS HAULED AND APPROPRIATE TRACK RESISTANCE FOR INDUSTRIAL SHUNTING | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (A) WHOLE TRAIN ON STRAIGHT RESISTANCE 20 LBS PER TON TO COVER STARTING | | | | | | | | | | (B) HALF TRAIN ON 300' CURVE AND HALF TRAIN ON STRAIGHT TRACK RESISTANCE 23 LBS PER TON | | | | | | | | | | (C) WHOLE TRAIN ON 300' CURVE RESISTANCE 30 lbs PER TON | | | | | | | |
| GROSS LOAD HAULED IN TONS AT A SPEED OF 4 M.P.H | 100 TONS | 200 TONS | 300 TONS | 400 TONS | 500 TONS | 600 TONS | 700 TONS | 800 TONS | 900 TONS | 1000 TONS | 100 TONS | 200 TONS | 300 TONS | 400 TONS | 500 TONS | 600 TONS | 700 TONS | 800 TONS | 900 TONS | 1000 TONS | 100 TONS | 200 TONS | 300 TONS | 400 TONS | 500 TONS | 600 TONS | 700 TONS | 800 TONS |
| TRACTIVE EFFORT REQD IN LBS | 2000 | 4000 | 6,000 | 8000 | 10,000 | 12,000 | 14,000 | 16,000 | 18,000 | 20,000 | 2300 | 4600 | 6900 | 9,200 | 11,500 | 13800 | 16,100 | 18,400 | 20 700 | 23,000 | 3000 | 6000 | 9000 | 12000 | 15000 | 18000 | 21,000 | 24000 |
| RAIL HORSEPOWER AT SPEED OF 4 MILES PER HOUR | 21·4 RHP | 42 RHP | 64 RHP | 85 RHP | 106 RHP | 128 RHP | 150 RHP | 170 RHP | 192 RHP | 212 RHP | 25 RHP | 49 RHP | 73 RHP | 98 RHP | 122 RHP | 147 RHP | 170 RHP | 196 BHP | 220 RHP | 245 RHP | 32 RHP | 64 RHP | 96 RHP | 128 RHP | 160 RHP | 192 RHP | 224 RHP | 256 RHP |
| IF STEAM LOCOMOTIVE EMPLOYED SIZE OF CYLINDER BORE REQD | 6" DIA | 8" DIA | 9½" DIA | 10½ DIA | 12" DIA | 13" DIA | 14" DIA | 15" DIA | 16" DIA | 16½ DIA | 6½" DIA | 8½" DIA | 10" DIA | 11½ DIA | 12½ DIA | 14" DIA | 15" DIA | 16" DIA | 17" DIA | 18" DIA | 7" DIA | 9½ DIA | 11" DIA | 13" DIA | 14½ DIA | 16" DIA | 17" DIA | 18 DIA |
| IF STRAIGHT DIESEL LOCOMOTIVE EMPLOYED - MINIMUM BHP REQD AT PRIME MOVER OF LOCOMOTIVE ASSUMING 20% TRANSMISSION AND OTHER LOSSES | 27 BHP | 53 BHP | 80 BHP | 106 BHP | 133 BHP | 160 BHP | 187 BHP | 212 BHP | 240 BHP | 265 BHP | 32 BHP | 61 BHP | 92 BHP | 122 BHP | 153 BHP | 184 BHP | 212 BHP | 246 BHP | 275 BHP | 306 BHP | 40 BHP | 80 BHP | 120 BHP | 160 BHP | 200 BHP | 240 BHP | 280 BHP | 320 BHP |

Fig. 2.

The following operating advantages of the diesel shunting locomotive are interesting:

(1) Very much lower fuel costs.
(2) No fuel used for raising steam and no time lost in this respect.
(3) No stand-by losses if the locomotive is obliged to wait long periods for traffic.
(4) Less time for fuelling as the locomotive can be filled up for 24 hours' service or even longer.
(5) Unnecessary to take locomotive out of traffic to take water perhaps two or three times a day.
(6) Owing to its even torque the diesel locomotive has a better adhesion factor.
(7) The wear and tear on side rod brasses, crank pins, axle boxes and horn blocks is less than on a steam locomotive.
(8) With the fluid coupling is it possible to obtain the maximum tractive effort immediately and since this is evenly applied, wheel slip should be less frequent requiring less sanding with consequent increased tyre life.
(9) The driver's view of the track is not obstructed by large saddle tanks and it is possible for the driver to easily see the front buffer beam. This is a very important feature on tracks which are laid in and about docks and where conditions are congested.
(10) With self-changing synchromesh powerflow gearbox, hydraulic coupling, air brake equipment and good conditions in the driver's cabin, it is simple and convenient to drive.

### TABLES OF EQUIVALENT LOCOMOTIVE POWER.

Tables for ascertaining the relative size of steam locomotive or diesel locomotive are included in this article, and enable one to locate easily the b.h.p. required by a diesel locomotive to replace a given size of steam locomotive when employed on various loadings and operating under various conditions of track resistance.

The criterion for docks or industrial shunting is the drawbar pull of the tractive effort of the locomotive at a speed of 4 miles per hour, and in Fig. 2, tables A, B and C are based on this speed.

The resistances taken in tables A, B and C may at first sight appear high, but the maintenance of industrial tracks is seldom up to main line standards, and also industrial rolling stock, more

## *Locomotives for Heavy Dock Shunting—continued*

often than not, has a high proportion of grease-lubricated axle boxes. The size of steam locomotives indicated in the tables is based on 80% boiler pressure and the mechanical efficiency of the diesel locomotives is taken as 80%.

In dock shunting the general average resistance condition is probably that shewn in Table B, i.e. for half train on 300 feet radius curve and half train on straight track corresponding to a resistance of 23 lbs. per ton.

If the track is in poor condition a resistance as high as 30 lbs. per ton may be encountered on straight track, and if a conservative average resistance is required, 30 lbs. per ton may be assumed for general purposes to cover starting and acceleration on dock shunting duties.

**USE OF TABLES A B AND C IN FIGURE 2.**

Assume it is required to haul a train of 600 tons gross weight including locomotive round a curve of 300 feet radius and the whole train is on the curve, from Table C it will be found that the tractive effort required (at 30 lbs. per ton) will be 18,000 lbs. requiring a steam locomotive having 16-in. bore cylinders or a diesel locomotive of 240 b.h.p.

Now assume the same train of 600 tons on straight and level track using Table A. Based on 20 lbs. per ton resistance, the tractive effort required becomes 12,000 lbs. The steam locomotive should have a cylinder bore of not less than 13-in. The diesel locomotive required would be 160 b.h.p.

From these tables (or extensions thereof) examples for any tonnage hauled may readily be ascertained.

The size of steam locomotives most commonly found on dock undertakings are locomotives having cylinder bore sizes of 14-in., 15-in., 16-in. and 18-in. and for rapid appreciation of the comparative straight diesel locomotives the following table has been prepared:

**COMPARATIVE STEAM AND DIESEL LOCOMOTIVES.**

| Bore of Steam Loco | Approximate maximum tractive effort at 4 m p h. | Rail h.p. at 4 m.p.h. | B.H.P. required at prime mover of straight diesel loco. |
|---|---|---|---|
| 14-in. | 14,000 lbs. | 150 r.h.p. | 187 b.h.p. |
| 15-in. | 16,000 lbs. | 170 r.h.p. | 212 b.h.p. |
| 16-in. | 18,000 lbs. | 192 r.h.p. | 240 b.h.p. |
| 18-in. | 23,000 lbs. | 245 r.h.p. | 306 b.h.p. |

In view of the foregoing considerations it is not difficult to understand why diesel shunting locomotives have proved sluggish when tried on heavy industrial duties.

The writer is of the opinion that for heavy dock shunting duties straight diesel locomotives of not less than 300 b.h.p. should be employed. In the past, mistakes have often been made because it has been overlooked that with a diesel locomotive the power is more or less constant whereas with a steam locomotive it rises considerably with the rail speed due to the more economical use of steam at the higher piston speeds.

Smaller engines than 300 b.h.p., say 200 b.h.p., can of course be used on dock shunting duties, but careful consideration should be given to the work required of them in order to prevent excessive overload at the prime mover.

**GENERAL PARTICULARS OF RECENTLY CONSTRUCTED STRAIGHT DIESEL LOCOMOTIVES FOR INDUSTRIAL SHUNTING.**

General particulars are given of the four 300 b.h.p. and the three 200 b.h.p. locomotives recently ordered by the Port of Bristol Authority and also of a 300 b.h.p. locomotive recently supplied for steel works use:

**(a) 0-6-0 type 300 b.h.p. Straight Diesel Locomotives for the the Port of Bristol Authority.**

The prime mover is a Crossley, vertical scavenge pump diesel engine type EST 6 of the two-stroke non-reversing airless solid injection type. This engine has six cylinders in line and the power developed and governed at a speed of 750 r.p.m. is 300 b.h.p. 12-hour rating with 330 b.h.p. at 1-hour rating also at 750 r.p.m.

Power transmission is by Fluid Coupling and S.S.S. powerflow gearbox; the final drive is by means of jack shaft and coupling rods.

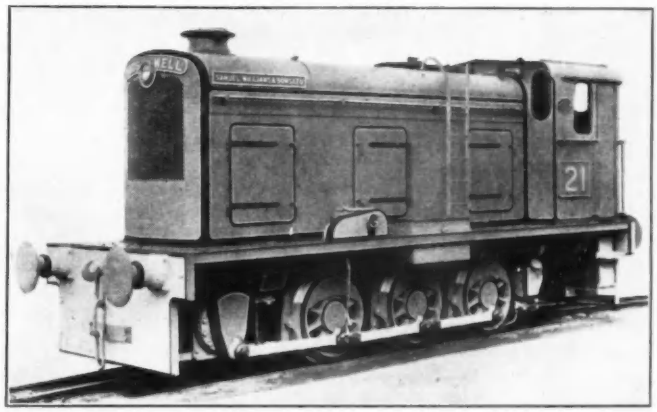


Fig. 3. 0-6-0 200 b.h.p. Straight Diesel Locomotive.

The principal particulars of these locomotives are:

| | |
|---|---|
| Length over buffer beams | about 26-ft. 0-in. |
| Height ... ... ... | 12-ft. 6-in. |
| Width ... ... ... | 8-ft. 6-in. |
| Wheels ... ... ... | 4-ft. 0-in. diam. on treads |
| Total wheel base 0-6-0 type | 10-ft. 0-in. |
| Sharpest curve locomotive will traverse ... | 100 feet radius |
| Total weight in working order ... ... | 45 tons |

The performance of the locomotive based on 300 b.h.p. or 12-hour rating at 85% mechanical efficiency is as follows:

| | Low Range Gears | | |
|---|---|---|---|
| Rail Speeds | 3.8 m.p.h. | 6.7 m.p.h. | 11.2 m.p.h. |
| Tractive Effort | 25,000 lbs. | 14,200 lbs. | 8,500 lbs. |
| | **High Range Gears** | | |
| Rail Speeds | 9.08 m.p.h. | 16 m.p.h. | 26.9 m.p.h. |
| Tractive Effort | 10,500 lbs. | 5,950 lbs. | 3,530 lbs. |

$$\text{Adhesion Factor} = \frac{45 \times 2240}{25{,}000} = 4$$

**(b) 0-6-0 type 200 b.h.p. Straight Diesel Locomotives for the Port of Bristol Authority.**

The prime mover on these locomotives is an eight cylinder Gardiner type 8 L 3 four-stroke engine having a 1-hour traction rating of 204 b.h.p. at 1,200 r.p.m. and power transmission is by means of fluid coupling and S.S.S. powerflow gearbox; the final drive is by means of jack shaft and coupling rods.

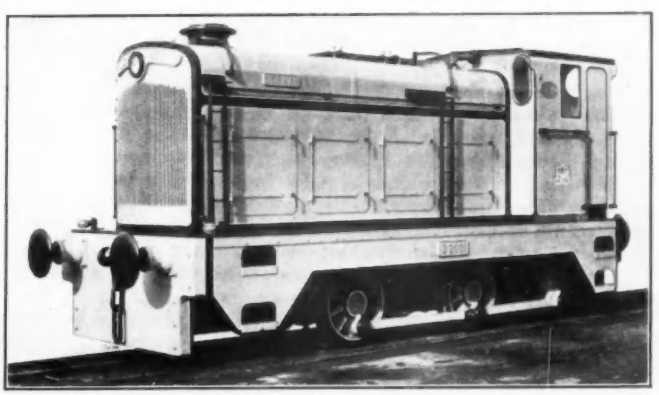


Fig. 4. 0-4-0 200 b.h.p. Diesel Locomotive supplied to the Port of Bristol Authority.

## *Locomotives for Heavy Dock Shunting—continued*

The main particulars of these locomotives are:

| | |
|---|---|
| Length over buffer beams | about 22-ft. 6-in. |
| Height ... ... ... | 10-ft. 10-in. |
| Width ... ... ... | 8-ft. 6-in. |
| Wheels ... ... ... | 3-ft. 0-in. diam. on treads |
| Total wheel base 0-6-0 type | 8-ft. 0-in. |
| Sharpest curve locomotive will traverse ... | about 110 feet radius |
| Total weight in working order ... ... | 30 tons |

The performance of these 200 b.h.p. locomotives based on the one hour traction rating of 204 b.h.p. and assuming 85% mechanical efficiency is as follows:

| Rail Speeds | 4 m.p.h. | 7½ m.p.h. | 15 m.p.h. |
|---|---|---|---|
| Tractive Effort | 16,250 lbs. | 8,660 lbs. | 4,330 lbs. |

$$\text{Adhesion Factor} = \frac{30 \times 2240}{16{,}250} = 4.1$$

**(c) 0-4-0 type 300 b.h.p. Straight Diesel Locomotive for Steel Works use.**

The prime mover in this instance is a Harland and Wolfe six-cylinder two-stroke engine having a continuous rating of 300 b.h.p. at 1,200 r.p.m., with safety devices fitted to warn the driver if the load exceeds 300 b.h.p. Here again power transmission is by means of fluid coupling and S.S.S. powerflow gearbox and the final drive by means of jack shaft and coupling rods.

**General particulars of locomotive:**

| | |
|---|---|
| Length over buffers . . | 23-ft. 5½-in. |
| Height ... ... | 12-ft. 0-in. |
| Width ... ... | 8-ft. 6-in. |
| Wheel Base (0-4-0 type) | 6-ft. 0-in. |
| Wheels ... ... | 3-ft. 6-in. diam. on tread |
| Weight of locomotive in working order ... | 40 tons |

The makers' rated performance is as under:

| Rail Speeds | 4½ m.p.h. | 8½ m.p.h. | 13 m.p.h. |
|---|---|---|---|
| Tractive Effort | 22,500 lbs. | 13,000 lbs. | 8,000 lbs. |

$$\text{Adhesion Factor} = \frac{40 \times 2240}{22{,}500} = 4$$

The details of these three types of locomotives represent the latest trend in the design of modern straight diesel locomotives for industrial shunting purposes.

Fig. 3 is a photograph of an 0-6-0 type 200 b.h.p. locomotive, while Fig. 4 is that of an 0-4-0 type diesel locomotive of 200 b.h.p. and similar tractive effort to the 200 b.h.p. locomotive fully described and was supplied to the Port of Bristol Authority in 1950.

The modern diesel locomotive is a reliable machine and it is astonishing how quickly and easily drivers coming from steam locomotive operation adapt themselves to its operation.

It is considered that the availability factor of the diesel locomotive will be higher than that of the steam locomotive as the latter is often, as previously mentioned, in workshops for protracted boiler repairs.

If suitable spare parts for the diesel locomotive are kept in stock there is no reason why overhauls of even a major nature should not be completed in very much shorter time than boiler overhauls on the steam locomotive.

The writer is of the opinion that the employment of the straight diesel locomotive for industrial shunting will greatly increase in the near future, and in consequence the first cost will be reduced, which again would tend to increase its employment. There is no doubt that if the various makers would produce a similar *standard range* of prime movers for diesel traction purposes, resulting in standardisation of locomotive frames and components generally, a price reduction could be effected with considerable advantage to all concerned.

*(To be continued)*

# Ore Discharge from Carriers

## Investigation into Handling Methods by the British Iron and Steel Research Association

The annual report of the British Iron and Steel Research Association, covering the year 1950, refers to the efforts made by the Association to complete as much as possible of the first stage of a comprehensive study of the handling of imported ore. The work has been guided by an Advisory Committee organised jointly by the Plant Engineering and Ironmaking Divisional panels; the Committee will report its findings to the Iron and Steel Federation's Executive Committee.

A large proportion of the Association's staff in both the mechanical and civil engineering sections has been engaged on the project, which has been divided into a number of studies. A study of actual handling conditions has been confined, so far, to the unloading of ships at wharves; the problem of transport and storage between port and works stockyard will be studied next year. The rate of ore discharge at six ports has been studied in detail to determine the factors affecting the turn-round time of ore-carrying vessels. These ports have been selected to cover various sizes and types of equipment and different working methods. Reports of facilities at Dagenham, Workington and Glasgow have been completed; work is proceeding at Middlesbrough and Port Talbot. Facilities at Barrow-in-Furness will be investigated later.

The knowledge gained in these studies, supplemented by information on the costing of unloading, will be used to prepare estimates of relative operating costs of each type of equipment under various circumstances. A preliminary examination is also being made of methods of cleaning out the last of the ore from ships' holds by mechanical means, since this part of the discharging is at present slow and requires much manual labour.

An assessment has been made from tidal data of the extent to which ships of various tonnages can gain access to ten representative British ports. A comparison has also been made between the sizes of ships actually using the ports and the computed maximum sizes of ships which could enter them. This has shown that considerably larger ships could be used, if other conditions, such as those of chartering, were favourable. An attempt is being made by a comparison of known performance figures in relation to ship design to assess the suitability of various classes of ships for carrying ore. In this way it is hoped to specify the important points in the design of future ore-carrying vessels.

Work for the Plant Engineering Division has been concentrated on problems connected with traffic, such as the probability of emptying a stock yard of a given size which feeds a furnace at a steady rate and is replenished by train-loads of raw materials arriving with a known distribution in time. The inter-relation of the time a ship waits outside a port and the time it occupies a berth has also been studied and has been solved analytically for a single berth port. Work on the much more difficult problem of a port with a number of berths is proceeding.

The Operational Research Section of the Association have also been concerned in the project. Work began with the collection of statistics of past imports and an assessment was made of future port throughputs on the basis of estimates made by the Iron and Steel Federation. Particulars of over 2,500 cargoes unshipped in the years 1948 and 1949 have been recorded on punched cards, showing for each cargo such details as the names of the foreign and British port visited; type and quantity of ore; voyage time, time waiting for a berth, and unloading time at the berth. From these the imports during that period have been tabulated according to ports of loading and discharge. The information is being analysed, and it is hoped to determine the effect of such factors as unloading equipment, type of ore and type of ship on the unloading rate, at the same time the relationship between wharf occupancy and delay in waiting for a berth are being considered, and cost factors are being obtained and analysed to determine the effects of various methods of speeding up turn-round and to assess their economic merits.

# Oil Pollution of Sea Water

## A Survey of Past Investigations and Legislation*

The question of international action on the subject of the pollution of the sea by oil is now before the United Nations and is to be considered by the Inter-Governmental Maritime Consultative Organisation (I.M.C.O.), when that body is established. In order that as much information as possible may be available, Member Governments have been invited to co-operate by carrying out certain investigations. As a result, the Ministry of Transport of the British Government has instituted a comprehensive research into all aspects of the problem.

Oil pollution of navigable waters came into prominence after the first world war, when the internal combustion engine showed rapid development as a means of ship propulsion, and the use of oil for firing steamship boilers became a common practice. In view of the growing importance of the matter it is interesting to review the effects of this type of pollution, the problems that have arisen, the possible remedies, and the legislation and intergovernmental action which have already been effected, together with the studies which are now being carried out.

### EFFECTS OF OIL POLLUTION

The main effects of oil pollution are the damage caused to birds, sea vegetation, fish and the fishing industry. Another problem is the hazards to ports through the possibility of floating oil taking fire.

There is no lack of evidence that the effect of oil upon sea birds can be definitely bad, and the trend of opinion expressed by Governments in their replies to enquiries instituted before the last war shew that the effect upon fish in the high seas is doubtful, except in the opinion of one Government which stated that fish eggs are harmfully affected by oils, and that oil in coastal waters also affects seaweed and fish food, serious damage having been observed. In some cases fish died or were no longer edible, and on occasions, some fishing districts had to be abandoned and fishing nets were adversely affected. As to fire hazards in harbours and estuaries, it goes without saying that the spillage of oil increases the risk of fire, and several fires due to oil on the surface of the water becoming ignited, have been reported in many ports.

It is to be noted that not many countries at the time had instituted scientific studies concerning the extent of sea pollution by oil and little evidence had been collected on this particular point. Some countries however which had made a special study of the question, reached the conclusion that oil could remain on the surface almost indefinitely, or at least for a very long time, and moreover, even if the volatile elements of oils disappeared by evaporation, the quantity that evaporated represented only a very small proportion of the total volume.

Regarding the drifting of oil, many experiences proved that a range of more than fifty miles was not uncommon, while in one instance, oil had been detected five hundred miles away from the point of discharge. One Government reached the conclusion that oil could be diffused in the form of a film of invisible thinness within a hundred hours from the time of discharge and at a very great distance from the source, depending on such conditions as the nature and amount of oil discharged, the prevailing wind and currents and the average surface conditions of the beaches.

### INCREASE IN THE USE OF OIL BY SHIPPING

As the number and kind of vessels in use have a more or less direct effect on the degree of pollution of the sea, it is important to compare the size and composition of today's merchant fleet with that of years ago. In June 1939 the world merchant fleet consisted of approximately 69½ million tons gross of vessels of 100 tons and over, while in June 1948 the figure was 81 million tons representing an increase of 11½ million tons gross. In 1914 nearly 89 per cent. were coal-burning vessels, while at present only 22 per cent. of the world merchant fleet depends on coal for fuel.

The trend towards the adoption of oil as fuel during the years 1914-1948 is shown below, the figures being percentages of the total world shipping tonnage.

| | 1914 | 1935 | 1939 | 1948 |
|---|---|---|---|---|
| Coal ... ... ... ... ... | 88.84 | 50.15 | 44.67 | 22.30 |
| Oil fuel for boilers ... ... ... | 2.65 | 30.65 | 29.63 | 55.53 |
| Oil for internal combustion engines | 0.45 | 17.42 | 24.34 | 21.20 |
| Sailing ships, non-propelled barges etc. | 8.06 | 1.78 | 1.36 | 0.97 |
| | 100.00 | 100.00 | 100.00 | 100.00 |

In the ten years from 1939-1949 the world tanker tonnage of 500 d.w. tons and over, increased from 16 million tons d.w. to nearly 30 million tons d.w.

These various figures shew that the total world merchant fleet has greatly enlarged and that, as might be expected, the number of motor vessels and tankers has also greatly increased, thus indicating an even greater potential danger of excessive oil pollution of the seas.

### REMEDIES SUGGESTED

At the present time, pending the results of the investigations now being carried out by Governments, it is of course not possible to put forward remedial measures of a final and international character. Those measures which have been instituted already by certain countries apply only to their own territorial waters. It should be mentioned, however, that in early endeavours to establish international agreement upon the subject of pollution it was was suggested, inter alia, that " prohibited zones " be established extending seaward a distance of 150 miles from the coasts, together with the provision of oil separators in ports and on board ships.

In replies to a questionnaire sent to Governments in 1935 by the Comunications and Transit Organization of the League of Nations, it was indicated that the maritime countries owning an important merchant fleet were on the whole against the provision of oil separators as far as existing vessels were concerned. Whereas the countries which possessed a comparatively small merchant marine were in favour of this remedy. The former pointed out that the expense would be very great and some of them even expressed the opinion that the beneficial results which could be expected were doubtful and gave the following reasons:

(1) At that time no available separator was of sufficient capacity to meet the requirements of an average size tanker.
(2) Where ships carry fuel oil in bunkers only or in bunkers and double bottom oil tanks, but do not use either bunkers or tanks for water ballast, oil separators appeared to be unnecessary.
(3) Separators were not an infallible guarantee against pollution, as mud and sand can greatly affect their efficiency.
(4) When the specific gravity of oil (bunker type) is high its separation from water becomes very difficult or even impossible.

The majority of countries however appeared to be in favour of compulsory provision of oil separators on all new vessels carrying cargoes of oil or using liquid fuel.

With regard to oil separator appliances in ports, in 1935 only three countries had them available, one of which was the United Kingdom. At the present time very few vessels are fitted with oil separators and the capacity of them varies from 5 tons to 150 tons or more per hour.

### LEGISLATION AND INTERNATIONAL ACTION

Although the implications involved in the escape of oil and the disposal of oily water had received the serious attention of Governments for some years it was not until 1922 that the first legislation was instituted — by Great Britain, when the Oil in Navigable Waters Act was passed by the United Kingdom Government. This Act came into force on the 1st January 1923 and was closely followed by the somewhat similar Oil Pollution Act of 1924 of the United States and Acts of Legislature by other Governments.

The U.K. Act of Parliament had as its object the prevention of the discharge or escape, of oil into harbours and other confined water areas on the British coast, and is still in force. Under the terms of the Act, ships are prohibited from pumping waste oil, or allowing it to escape, within the territorial waters of Great Britain and Northern Ireland. Harbour and Port Authorities, on their part, have the obligation of providing receptacles for such fluid, while ships are in port, at prices, which in accordance with agree-

*Based largely upon the Report of the Secretary General of the United Nations to the Transport and Communications Commission upon " Pollution of sea water by oil," December, 1949.

## *Oil Pollution of Sea Water—continued*

ment come to with the shipowners, will " cover expenses and leave some reasonable remuneration on the outlay." It was hoped by these means to remove the risk of serious conflagration among shipping and the attendant danger to wharves and quayside structures, and there seems to be no question, so far as the British Isles are concerned, that a great measure of success has been the result. There was however no international agreement upon the subject and without which, no complete abatement of the deleterious effects of oil pollution could resist.

In 1924 the Chamber of Shipping of the United Kingdom, recognising the Internaional importance of preventing the danger of oil pollution, made the " prohibited zone " recommendations already referred to and in 1926 the International Shipping Conference (since 1948 the " International Chamber of Shipping ") made a special study of the problem. Owing to lack of precise data the Conference was unable to present definite recommendations but agreed voluntarily to adopt the British proposal—to refrain from discharging oil or oily water within a certain distance from the coasts.

This initial conference on the subject was followed, at the invitation of the United States Government, by the Preliminary Conference on Oil Pollution of Navigable Waters, which met at Washington in 1926. This was a gathering of technical experts to facilitate an exchange of views for the purpose of formulating proposals for international agreement. A report made by an American Interdepartmental Committee to the Secretary of State of the United States, was considered and the text of a draft convention was agreed, no agreement however was actually signed.

In 1934 the Government of the United Kingdom, having considered that the pollution of the sea owing to the discharge of oil or oily water was increasing, submitted to the League of Nations the question of the pollution of its sea coasts, damage to inshore fisheries and destruction of sea birds caused by the discharge of oil from vessels at sea. At the 15th Ordinary Assembly of the League in 1934, it was agreed that the Communications and Transit Organization of the League should undertake an initial enquiry into oil pollution by convening a committee of experts from various countries to study the problem. As a result, after considering the recommendations of this organization, the Council of the League of Nations authorized the Communications and Transit Organizations to conduct preliminary studies and gather data and information with a view to the future conclusion of international convention in regard to oil pollution of the sea.

In accordance with this resolution a circular letter together with a questionnaire was addressed in 1935 to 69 member and non-member States of the League, the replies to which have been referred to. On the whole they showed that the problem was a serious one and would justify an international convention. Acting upon resolutions of the Council of the League of Nations, the Committee of Experts, reconvened, propared a draft convention together with a draft Final Act, on the basis of the draft Washington Convention of 1926 and of the answers received from Governments to the questionnaire mentioned above.

These drafts were circulated to all the countries concerned and nearly all the replies received from the States with sea coasts were in favour of concluding a convention based upon them. It was thereupon decided to convene an international conference to adopt the draft convention.

This conference, however, never took place, because three important countries—Germany, Japan and Italy—whose participation was considered necessary from a technical point of view, were not at the time in a position to attend a conference convened under the auspices of the League of Nations. Finally, on account of the War, the matter was not further pursued.

It was not until 1948-49 that the gravity of oil pollution of the sea again began to be stressed, owing in particular to the fact that oil had superseded coal in a very large number of merchant ships and tankers. The matter was discussed in 1949 by the Chamber of Shipping of the United Kingdom and some specific suggestions and recommendations were made. One of these was that a solution of the problem must be sought in the provision of shore installations by Port Authorities for disposing of oily waste; and that in the meantime owners of tankers should periodically impress upon their shipmasters the importance of the observance of the regulations, which had been made by certain Governments as to the non-discharge of oil or oily waste within 50 miles of any coast; also that in the case of vessels outward bound to a loading port, no oily ballast or bilge water should be discharged overboard until the ship was at least 100 miles clear of land.

In the meantime the matter was brought to the attention of the United Nations Economic and Social Council, and the Secretary General of the United Nations Organization in December 1949 addressed a Report to the Transport and Communications Commission pointing out, inter alia, that it would appear that a study of the problem of pollution of the sea by oil would fall within the field of competence of the Inter-Governmental Maritime Consultation Organization (created at the United Nations Maritime Conference in Geneva in 1948), when once that organization commenced functioning.

### FUTURE PLANS

The Transport and Communication Commission considered the Report and at a session held at Lake Success, New York in 1950 reported to the Economic and Social Council, agreeing that IMCO would be the competent agency to handle the matter in due course, and recommending in the meantime, that the Secretary General be instructed to request the views of Member Governments upon certain aspects, one of which was as to whether the scope of examination of the problem should be extended to cover the possible future pollution of sea water by atomic waste from fuel which may be used in ships in the future. Further recommendations were to the effect that Member Governments, which possess the facilities to do so, be requested to undertake research studies on the oil pollution problem forthwith.

The Secretary General of the United Nations approached the British Government towards the end of last year with the result that its views upon certain points have already been given, and the Ministry of Transport has instituted the investigation which has been referred to in the opening paragraph of this article.

### PRESENT INVESTIGATIONS

The research being carried out by the Ministry follows the same general lines of enquiry as those made by the Board of Trade in 1933-35, a review of some of the replies to which have also been mentioned. Briefly some of the more important heads of enquiry are as follows:

(a) The present extent of oil pollution, whether there has been any marked increase or decrease in recent years, together with the cost of pollution and its effects.

(b) Statistics for selected years (1914, 1939, 1949) indicating on both a numerical and tonnage basis, the number of oil-burning, oil-carrying and other ships belonging to the United Kingdom.

(c) A survey of oil separating facilities at present provided in docks and harbours for the use of shipping the types of apparatus, their capacity and efficiency, the extent to which they are used, together with the manner of disposal of the oil sludge from ships.

(d) The number of British oil-burning and oil-carrying vessels already fitted with oil separators and of those not so fitted.

(e) Records of fires which have taken place in harbours from oil ignited on the surface of the water.

(f) The drift of oil on the surface of the sea, having regard to the prevailing winds and currents, and the width of zones in which the discharge of oil and oily water should be prohibited in order to give effective protection to the sea shores.

(g) The possibility that investigation may be desirable into the question of treating oil waste by chemical means to render it inocuous.

(h) Whether it is desirable to carry out further enquiries and research into the effect of oil on bird life, fish in the open sea, inshore and shell fish, marine vegetation and the amenities of coastal areas.

# Fundamentals of Harbour Engineering

## Some Features of German Design and Lay-Out

By Baudirektor Dr.-Ing. ARVED BOLLE, Hamburg†

THE FACTS described below are known to any expert harbour engineer. However, a short description of the fundamental principles will be readily appreciated by many readers, and students and young engineers interested in maritime engineering in particular will find it useful for reference purposes.

Harbour engineering work comprises breakwaters, moles, training walls and channel demarkation ensuring safe navigation and dispatch of ships; furthermore there are works like quays, sheds, warehouses, railway installations and roads, all of which service a port. Harbour defence works will not be dealt with, nor will problems of open or tidal ports as opposed to wet docks* be investigated. It is merely assumed that an area suitable for the construction of a harbour is available either immediately on the coast or further inland on a river or canal opening upon the sea (Fig. 1). This article is limited to the description of conditions particular to seaports which, however, may equally be applied to inland water harbours.

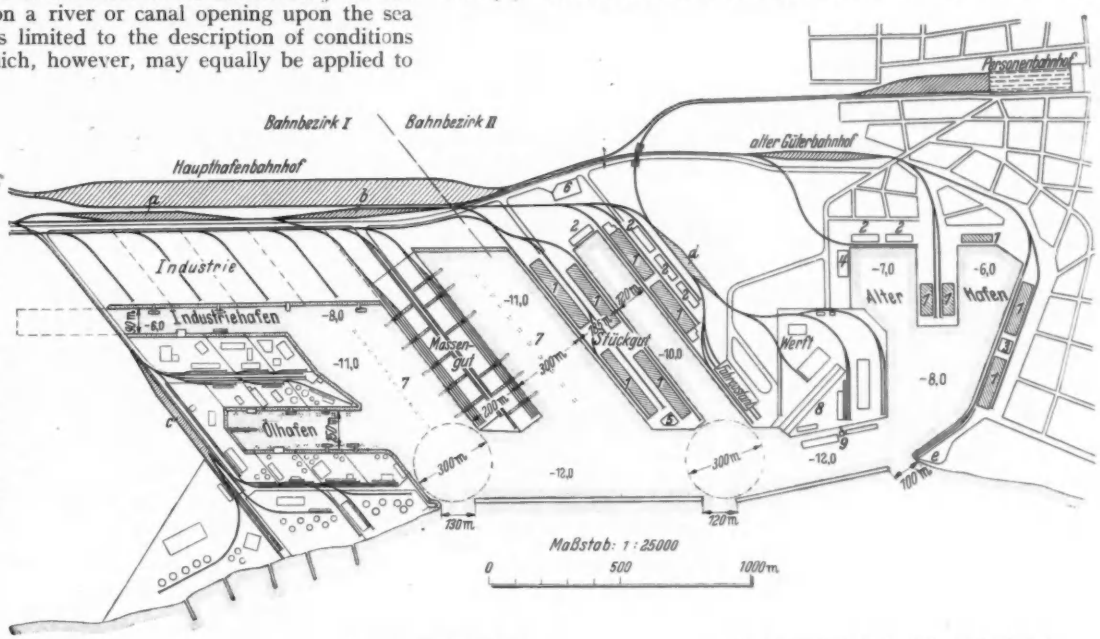



Fig. 1. Diagram of a port's plan containing a diagrammatic grouping of the most important facilities to be co-ordinated as favourably as possible within a port layout. The Harbour facilities are as follows:—(1) transit sheds, (2) warehouses, (3) grain silos, (4) cold storage, (5) administration, (6) fire brigades, (7) berths for handling cargo overside, (8) shipyards, (9) floating docks. Railway facilities:— (a) district yard I, (b) district yard II, (c) district yard for oil harbour, (d) subyard for shipyard, (e) open storage sidings.

Bahnbezirk = rail district
Haupthafenbahnhof = main port marshalling yard
Industrie = industrial area
Industriehafen = industrial port
Ölhafen = oil harbour
Massengut = bulk goods
Stückgut = general cargo
Fahrgastanl = passenger terminal
Alter Güterbahnhof = old goods depot
Werft = shipyard
Personenbahnhof = station
Alter Hafen = old port

### APPROACH CHANNELS, PORT ENTRANCES AND DEPTH OF WATER

We begin with the approach and entrance to the harbour basins. In this respect the size of ships (see Table 1) is of predominant importance. The draught of a normal cargo vessel on the high seas to-day attains almost 30-ft. An increase to 33-ft. must however be considered well within reach of possibilities. The modern American tankers of 30,000 tons with a length of 607-ft. and a beam of 82-ft. already draw 33-ft. The measurements of liners may now have reached an upper limit when one considers the *Queen Mary* with 81,235 tons gross, 974-ft. in length, 118-ft. beam and a draught of 39-ft. New ships on the stocks show considerably smaller dimensions. This may be due to competition by air travel.

**TABLE I**
Increase of Ships' dimensions since 1910

| | | Length ft. | Beam ft. | Draught (Loaded) ft. | Gross Tonnage |
|---|---|---|---|---|---|
| Typical cargo vessel ... | 1910 | 406 | 48 | 22 6 | 4504 |
| ,, ,, ,, ... | 1920 | 427 | 54 | 24 | 5627 |
| ,, ,, ,, ... | 1943 | 468 | 63 | 27 6 | 6165 |
| American C2-type ... | 1949 | 443 | 57 | 27 9 | 7176 |

†Translated from an article published in *Der Bauingenieur* 1950, No. 6, Springer Verlag, Berlin.

*The use of locks involves loss of time and added expense; therefore wet docks should be built only in case of absolute necessity.

At M.L.W. the required depth of the entrance results (a) from the depth sufficient to meet the requirements of the deepest draughted vessels which are likely to frequent the port, (b) an addition of 6-in. for fresh water, (c) an additional allowance below the keelson of between 2 to 3-ft. (depending on local conditions and (d) a reserve which should not be too small to take care of increasing dimensions of ships. In the basins, in case of (a) above, depth of water should be calculated to suit that type of ship which is expected to be handled at the site. The depth calculated on the basis of factors (a) to (d) above need not be provided immediately. It is sufficient that adjacent harbour works are founded deep enough. In order to keep the cost for entrances at a low figure berths for passenger liners and tankers ought to be so located as to reach them by the shortest route from the sea, always provided local conditions permit such a layout.

The width of entrance (400 to 1,300-ft.) depends upon the number and size of ships frequenting the port. It will prove profitable to draw a comparison with other ports of similar size and trade. The ship's size also determines the diameter of the turning basin to be provided in connection with the basin entrances. An appropriate size is 1,000-ft. In most ports it will be necessary to provide a sheet of water for compass swinging with a diameter of some 1,500 to 2,000-ft.

## *Fundamentals of Harbour Engineering—continued*

### BASINS

The need for unrestricted navigational facilities, favourable road and railway connections and for economical use of water and land areas will determine the location and direction, shape and dimensions of harbour basins subject, however, mostly to certain forms of development imposed by nature. Fig. 2 demonstrates the basic forms of basins in arrangement vertical, parallel or at an angle to the shore line. Frequently difficulties will arise in deciding upon the correct situation of the entrance to basins. The engineer will then be wise to consult with pilots, harbour masters, ship owners, shed masters, tug captains and so forth. The result of such consultations will in most cases lead to a compromise, preference being given under all circumstances to safety of navigation.

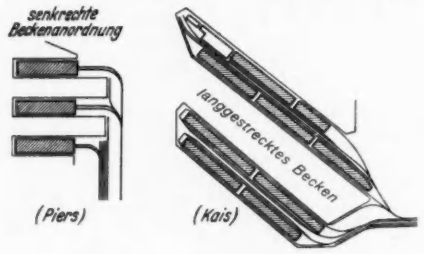



Fig. 2 (left). Basic forms of harbour basins.

Fig. 3 (right). Grain vessel discharging overside (note extent of water space required).

senkrechte Beckenanordnung = basins arranged vertically
(Piers) = piers
langgestrecktes Becken = extended basin
schräge Beckenanordnung = basins arranged diagonally
(Kais) = quays

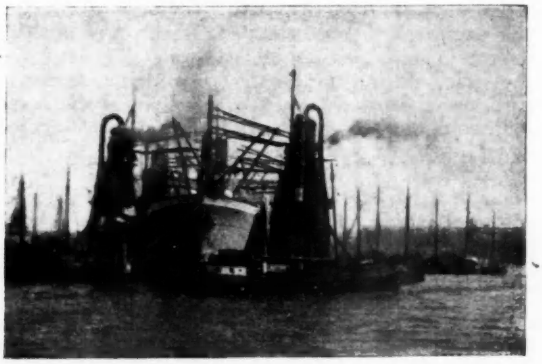
The discussion of the pros and cons as to different basic forms would lead too far, particularly so, since text books on harbour engineering give comprehensive advice on this matter. It is evident that from a nautical point of view and in respect of railway connection the vertical arrangement of basins (forming piers) will complicate matters considerably more than diagonal basins. The minimum length will be chosen to accommodate one or two ships, the maximum length will depend mostly on railway-technical considerations (see paragraph on Rail and Roads). The basin width will be decided by requirements for safe passage of ships to the rear end of the basin. Three to 4 times the ship's beam should be selected as a minimum. According to size of ships to be considered the width of the basin will be found to be between 260 to 560-ft. If ships discharge into barges overside the width must be increased to provide for floating gear and inland watercraft lying alongside the deep-sea vessel. Width of basin might then reach 1,000-ft.

### OTHER WATER AREAS FOR THE ACCOMMODATION OF DEEP-SEA VESSELS AND INLAND WATERCRAFT

Apart from the basins proper many ports include water areas with facilities for the mooring of ships (dolphins or buoys) which are at the disposal of ships temporarily laid up or waiting to be berthed at a quay. In addition these moorings are frequently used when handling cargo overside (Fig. 3). In this connection it is of interest that the discharge of a grain vessel of 9,300 tons loading capacity into coastal and inland watercraft requires a water area of about 205,000 sq. ft.

Sea ports with a high freqency of inland water transport require special access roads, working space and, of course, berths which facilitate the breaking up and assembly of tows. In such harbour basins where deep-sea and inland water vessel come into immediate contact, i.e. when handling goods simultaneously on to the quay and overside (Fig. 4), there will be need for larger basin widths.

The mooring of vessels on open water areas is facilitated by means of buoys and dolphins. These may be of concrete, steel or timber (concentrated group of piles). These dolphins seldom are of rigid construction, in the majority they are built to afford elasticity to destroy the momentum of ships when mooring. Concentrated groups of piles of the elastic type built of timber with, to some extent, semi-rigid timber bracings have proved satisfactory for many decades. Amongst others, a special characteristic of timber dolphins is the arrangement by which the piles are driven in trestle form, thus giving a better degree of resistance. The desire to obtain piled constructions of long life coupled with the shortage of timber in some countries, amongst which Germany finds herself since the last war, led to the development of dolphins built in steel. In this case it is of importance—considering the lower elasticity of steel compared with that of timber—to obtain a maximum of elasticity in the compound effect of the dolphin.



When building steel dolphins, instead of framework bracings, articulated connections are in use in order to produce a favourable braking effect. There is little doubt that steel dolphins eventually will carry the day, however, nothing definite can be said as to their most effective design. Many years will pass until generally accepted rules have been established. In the meantime an attempt should be made to choose, amongst information from time to time released by different harbours, the most suitable design for the intended purpose.

### LAND AREAS FOR HANDLING GENERAL CARGO

Any land areas servicing the port should be above high water level or surrounded by walls to exclude the tides. In the former it will be sufficient to provide shore revetment together with berthing facilities (piers, stages, dolphins); however, quay walls will be the rule. Fig. 5 shows 3 customary basic forms for deep-water quays (piled, caisson and block work construction). The decision of the type chosen will depend upon building materials available, nature of the ground and local peculiarities or customs and—last but least—economic considerations. An important element of piled construction is the steel sheet piling for which manufacturers are offering sections of steadily improving design and lower weight. The combined use of steel sheet piling and steel piles has produced satisfactory results. The danger of corrosion,

Fig. 4. A large cargo liner loads simultaneously from quay and coastal vessel (combined operation: quay and overside).

## *Fundamentals of Harbour Engineering—continued*

frequently underrated, should be mentioned in this connection and its successful prevention by use of copper alloy steel of appropriate section. Just as quay designs vary, so does their fitting out with bollards, fendering, fender piles and steel ladders vary in different ports. Pronounced differences of opinion exist particularly in respect of the use of rubbing piles. Due to shortage of timber in Germany since the end of the war steel piles frequently replace the timber piles.

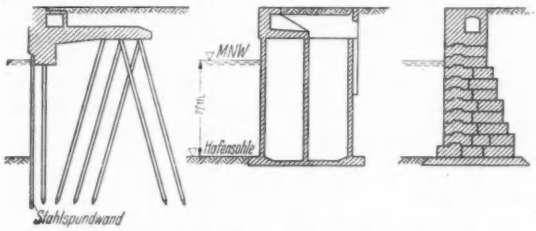



Fig. 5. Basic forms of modern quay walls.
Stahlspundwand = steel sheet piling
MNW = mean low water
Hafensohle = harbour bed

The extent and arrangement of land areas supporting quay berths depend upon the use they are intended for. According to Mr. Chester H. Marshall of the American Association of Port Authorities (1943) wharf space required to handle a full cargo —one way—of a ship of 6.165 tons gross, based upon block stowage on the wharf 10-ft. high, plus nominal allowance for roadways aisles was, 475-ft. long by 200-ft. wide.

This, of course, is only an estimate; however, it gives an idea of the size of the area of land strips needed to service a quay berth. Normally, either along the river front or on a pier several berths are located in line. Lengths of piers vary from 500-ft. to 3,300-ft., but even longer ones are in existence (see paragraph Rail and Roads). Fig. 6 gives an example of the cross-sectional arrangement of a modern pier, or quay suitable to handle on either side the largest type of general cargo vessels. This pier has a width of 610-ft.; for the dispatch of smaller vessels piers about 250-ft. in width will suffice. Fig. 6 also gives an idea of the equipment of the pier with cranes, sheds, tracks and roads which are dealt with in more detail below.

### RAIL AND ROADS

Rail and roads form the feeders and distributive arteries on land. They must be so designed as to allow the dispatch of inward and outward goods to an extent equal to the handling capacity of the quay. The acceptance of railway wagons from the interior destined for the port and their distribution within the port, as well as the assembly and re-dispatch of wagons belong to the duties of a port railway system (Fig. 7). This is done consecutively by the marshalling yard of the state railway, the main marshalling yard of the port railway, its district yard (or sub-yard) and finally at the loading tracks and vice-versa. The district yard is especially important for the unhampered serving of loading tracks on the quay. If the district yard is too far distant from the quay or non-existent for some reason, then the arrangement of special sorting sidings will be required for quick dispatch. These sidings are most suitably located at the root of the pier or, should this not be feasible, in the centre of the pier between the rows of sheds.

In order to decide upon the arrangement of tracks on general cargo quays it becomes essential to consider the ratio between railway, inland water transport and road haulage. Should the railway service be predominant, i.e, in the case of expectancy of heavy transfer of goods directly from ship to wagon or vice-versa it is advisable to concentrate the tracks on the water side of the quay. Too small a number of loading tracks on the water side of sheds may cause delays in the dispatch of ships if direct transfer of goods is needed. The number of tracks on the water side of sheds varies from none to four. No track at all on the water side (only to be found in old harbours) implies dispatch by road haulage from the quay; one track only allows occasional transfer of heavy pieces. It is of advantage to pave in a single track, and indeed all tracks, in order to facilitate the use of motor lorries. It is only when two tracks, one of which may be used if necessary as a through or service track, are available that cargo can be handled by rail to any great extent. Modern general cargo quays in European ports are now usually equipped with three tracks (two loading and one service track). Four tracks on the water side are justified only in case of a clear predominance of railway dispatch and are also the upper limit since a further increase would demand cranes of extreme length of jib and excessive weight.

On the land side of quay sheds only two loading tracks are required as it is not customary in Germany to load goods across more tracks. All other tracks on the land side are through, service, sorting or shunting tracks. The latter, however, will best be located at the shore end of the pier or quay to save width.

Differences of opinion exist as to the switch connections between loading tracks. Opinion is unanimous that too great a length of loading tracks is unfavourable. Switches are needed in order to exchange wagons during handling of cargo. Up to three connections are therefore to be found per berth. A minimum requirement is the subdivision of quay tracks according to the number of berths. From the point of view of shunting requirements a certain length of quay should not be exceeded. According to experience made at Hamburg a quay length of 2,650-ft. is still acceptable for three tracks on the water side. Quay lengths of 4,900-ft., however, have proved unsatisfactory.

Details of the construction of tracks will conform to the customary regulations for railway construction work and goods service. On the basis of German regulations the minimum distance between track centres is 14.8-ft., distance from the loading platform 5.6-ft. and the curve radius not below 590-ft. Turntable connections should be avoided.

Apart from the railway wagon the motor lorry requires space at the quay sheds. Though the lorry is but a supplement of the other means of transport, nevertheless it demands quick despatch. Any overlapping of dispatch by wagon and lorry considerably disturbs railway service. The object of a well-established division of these two transportation feeders should always be kept in mind.

A definite separation of the two means of transport is possible by direct despatch of lorries within the shed (frequently in practice elsewhere than in German ports) or in such cases as allow, of roads on quays without railway tracks. However, as a rule tracks are required on both water and land side of the shed and in this case it is advisable to pave-in tracks on the shed side with the lesser railway service. Quay cross-section shown in Fig. 6, one possible solution amongst many, is based upon the separation of these two feeders. The point of gravity of railway dispatch in this case rests undoubtedly on the water side equipped with two loading tracks and one service track. The shore side of the shed is normally reserved for road vehicles. The paved-in track pro-

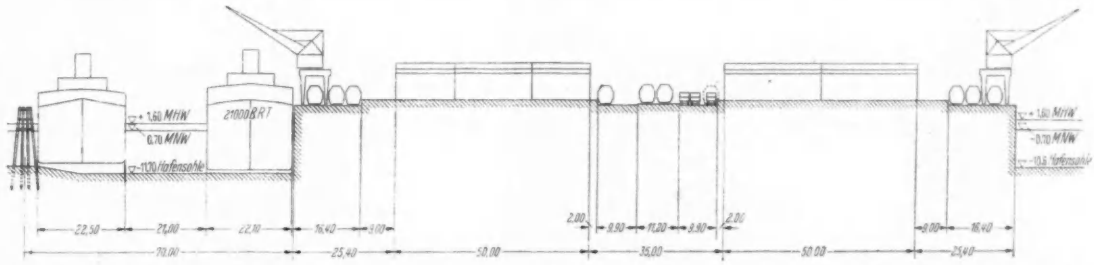



Fig. 6. Cross section of general cargo pier or quay.
MHW = mean high water
MNW = mean low water
Hafensohle = harbour bed
BRT = tons gross

## *Fundamentals of Harbour Engineering—continued*

vided on this side will only be used in case of heavy rail service (any tracks provided between roads on the permanent way are service tracks). The road width of 33-ft. shown in the cross-section (10-ft. each for two roadways and 13-ft. of paved-in track) are meant to take care of a comparatively heavy road vehicle service required for the dispatch of large cargo vessels Nevertheless these areas are only meant for the arrival and departure and loading and unloading of road vehicles. Additional parking places are required for vehicles awaiting dispatch. These will have to be so arranged within the pier area (possibly at the shore end) so that a further widening of the pier is avoided.

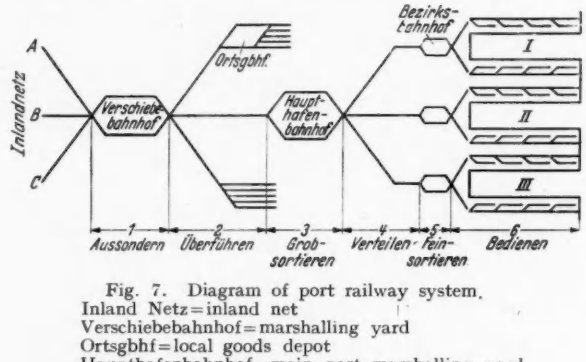



Fig. 7. Diagram of port railway system.
Inland Netz = inland net
Verschiebebahnhof = marshalling yard
Ortsgbhf = local goods depot
Haupthafenbahnhof = main port marshalling yard
Bezirksbahnhof = district yard
aussondern = sorting
überführen = transfer
grobsortieren = second sorting
verteilen = distribution
feinsortieren = final sorting
bedienen = servicing berths

Finally it will be of importance for the smooth running of all vehicle transport within the harbour area to provide through and access road connections of ample number and width (roads of 30 to 40-ft. width together with bicycle lanes and footpaths between main inland routes and quay facilities). In the case of heavy road vehicle transport special truck terminals should be provided at the periphery of the port.

### BUILDINGS (SHEDS, WAREHOUSES, ETC.)

The most important buildings of a general cargo port are the transit sheds (see Fig. 8-10. These sheds receive cargo from deep-sea vessels, inland watercraft, harbour craft, railway wagons and lorries. The cargo will remain in the shed just long enough to be removed by one of the above-mentioned means of transport after sorting and any other manipulation required by the trade. The cargo must be kept moving; stacking will therefore be limited to certain heights. When considering shed area requirements it is well to keep in mind that apart from space for spreading inward

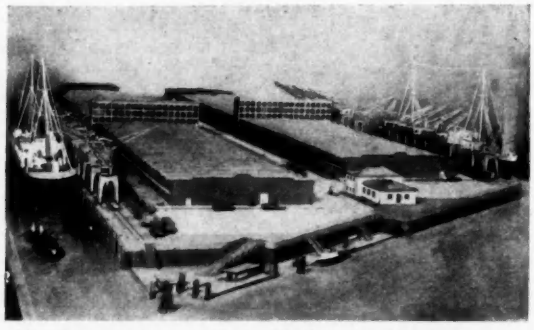


Fig. 8. Model of modern facilities for handling general cargo.

cargo ex deep-sea vessel other space will have to be held available for goods arriving for export. In order to ensure a continuous flow of goods by electric trucks etc. spacious aisles must be provided and the number of stanchions reduced to a minimum (clear space 4,500-5,000 sq. ft.). The shed length (up to 1,300-ft.) depends upon the characteristic type of ship (sub-division of sheds by means of fire-proof cross walls to the height of the shed roof based upon the principles of fire prevention). Widths vary from 100-200-ft.; the best width for operation (in the opinion of the writer 150-ft.) will be decided by local experience according to type of goods and bearing in mind that transverse movement over too large a distance becomes uneconomical. It will also depend upon local practice whether the shed floor will be built at ground level or to the height of the wagon platform. Sheds at ground level enable the dispatch of road vehicles within the sheds. This however, requires considerable width and loads must be lifted on to the vehicles' platform. In some cases a compromise is used by the provision of a floor sloping towards a platform on the land-side of the shed. In case of high level floors the platform on the water side will often be of great width. The dimension shown in Fig. 6 (30-ft.) not only admits the full use of electric trucks (longitudinal traffic) but also a temporary stacking of goods unloaded from the vessel and which are not intended to pass into the shed, but will be immediately transferred into railway wagons. On the land side a width of platform of 7-ft. is sufficient.

There is a great variance of opinion in respect to the provision of single, double or multi-storied sheds but double or more storied sheds will lead to a saving in width of piers. A discussion of the advantages and disadvantages would lead too far. The multi-storied sheds, however, involve so many operative difficulties that one-storied sheds will be preferable unless the handling and storage of goods are to be combined in one building. (See storage sheds below.) Structural details of single-storied sheds: doors on the water side should be so numerous that a maximum of shed access is provided; sliding doors allow up to 50 per cent. of openings, lift and sash-doors even more. On the land side a door to each bay is sufficient. The height of the shed depends upon the intended stacking height. In this connection proper ventilation should be considered. In Europe 13-20-ft. will be enough; in U.S.A. mechanical stacking demands greater heights. Proper lighting, so essential to unhampered operation and high efficiency of shed work, is attained by long broad lines of windows or by skylights. In addition artificial lighting is used and modern installations promote uniform luminosity at floor level. Roofs may be of reinforced concrete, timber or steel covered with timber and roofing felt or light-weight concrete slabs. Floors will have to withstand heavy weights and rough traffic handling. Loads will differ according to use of mechanical handling equipment and/or road vehicles and stresses be calculated to conform to floor boarding laid " in situ " or on proper foundations. In Germany (no road vehicles enter the shed) flooring frequently consists of timber boards of 2-3-in. thickness (of best quality hard wood) and have given satisfactory statical and insulating results. Due to shortage of timber reinforced concrete slabs (of a large size with steel edges or of small size without) have been given a trial. This type of floor slabs has been in use abroad for some considerable time.

As a result of competitive tenders it has been shown, since the war, that the choice of the main building for sheds is approximately the same price whether in reinforced concrete, steel or timber. Choice is therefore a matter of local experience or material availability. Should a shed be in the main intended for the handling of tropical fruits, heating must be installed and the outer walls and roof provided with insulation. For the proper functioning of shed working, a number of workmen's rooms, offices and welfare rooms are necessary, which may best be combined in special buildings (multi-storied to save space either at the ends or in the middle of the sheds). (Fig. 8.)

Long term storage of goods is done in warehouses. Since as a rule part-loads only pass into warehouses, these need not be located at expensive quays with deep water for sea-going vessels. To suit local conditions they are provided with road and rail access and frequently may be reached by inland water and/or harbour craft. At major ports it may be an advantage to concentrate warehouses in a special district.

In many cases buildings will prove profitable which combine space for short and long time storage. This type of warehouse shed may save port area and traffic routes within the port. They are, however, coupled with certain operative disadvantages such as reduced lighting and increased number of stanchions on the

## *Fundamentals of Harbour Engineering—continued*

ground floor storey which is meant for quick dispatch of cargo.

With regard to building methods of warehouses, the former timber structures have been replaced by reinforced concrete buildings (better fire risk). Whereas no limits are imposed as to their longitudinal development (fireproof cross walls will have to be provided) their width will vary between 65-100-ft. in view of lighting conditions. Warehouses are usually built to 5-6 storeys; provision of a cellar will suit the cool storage of goods packed in barrels. According to position of storey the useful load will vary from 300 to 400 lb./sq. ft. Refrigerated cool storage buildings are of special construction. Apart from sheds and warehouses a certain number of other buildings will be located within the port area, all serving the quick dispatch of goods and which should therefore be mentioned here. These buildings comprise administration, engineering staff, customs with facilities for dispatch of goods and passengers (free harbour fence), police stations, fire brigades, restaurant facilities and other social services and power stations Their siting will have to be considered with care.

In ports used principly for the dispatch of passenger liners, special quay facilities and buildings are required for the accommodation of passengers. A passenger quay should at all times be accessible for the largest liners and be provided with rail and road access. The dockside reception building (frequently combined with a railway station) should include waiting halls, restaurants and customs examination halls. Attention has already been called to the possibility of the dispatch of passengers from cargo liners in connection with quay sheds.

### QUAY CRANES

In principle the provision of mechanical handling equipment is a matter to be considered by the harbour engineer. This province, however, is so specialised and voluminous that even in treating the subject on general lines it is much too expensive to be dealt with within the limits of this article. On the other hand the type and size of handling equipment exercise such a decisive influence upon the form of rail and road facilities and of the sheds that, for this reason, some notes are required with regard to cranes. With the exception of a number of North American ports where special conditions exist, the full or semi-portal crane is an important feature of a quay dealing with general cargo. The kind of crane (in recent times almost wholly of the level luffing type), its capacity (between 2 and 5 tons, as a rule 3 tons) and their number (one crane per 65-ft. run of quay) are dependent on local conditions. If cargo is loaded across the the deep-sea vessel into inland water craft large radii (up to 115-ft. maximum, normally about 65-ft.) are required. The semi-portal crane rests on the water side upon the quay wall, and, on the landside, on the shed structure. It spans tracks and platform thus saving quay width and does not impede the handling of railway cargo. Inconvenient crossings of crane rails and railway tracks can be avoided. The support on two structures, however, leads to substantial maintenance charges in the case of unequal settlement of the two mediums, which occurs somewhat frequently. There is a further disadvantage in that the loading tracks and the platform are shadowed by the semi-portals if several cranes work in close proximity. To reduce the shadowing effect trials are being made at Bremen with semi-portals with three points of support only, i.e. one wheel on the shed crane rail. Furthermore the possibility of interchanging or of concentrating a large number of cranes at one point, if so required, is limited to quayage of equal cross-sectional shape at the water side.

### FACILITIES FOR HANDLING OF BULK GOODS

Ships carrying bulk goods (ore, coal, phosphates, timber, grain, potash and oil) require very fast dispatch; the time spent on inland transport to and from the bulk installations is neglible in this connection. A difference must however be noted between transhipment overside or by means of facilities on land. The handling overside by floating plant (elevators, bucket chains, coal elevators and grain suckers as well as grab cranes) requires, as has already been mentioned above, a large water area. In the case of handling bulk goods from ship to quay special installations, e g. bank revetment, mechanical handling and lifting plant, tracks, roads as well as storage facilities (open yards, halls, silos or tanks) will be required in accordance with the special conditions ot the site. For coal and ore useful loads of 10 to 15 tons and gantry bridges with spacing between supports up to 330-ft. will have to be considered, and require strong embankments. With regard to the extent of yards handling coal or ore it may only be mentioned that as a rule large areas are needed. The writer knows, e.g. of one ore handling yard of 1,970-ft. length and 330-ft. width of which 431,000 sq. ft. are straddled by gantry bridges of 177-ft. span. Below the cranes there are 11 tracks and an additional three behind.

The handling of timber also requires large space due to the need of considerable sorting; furthermore additional water areas are used in the case of timber stored in rafts. Grain handling plant may be arranged parallel to the shore line or on piers. The discharging as a rule is done by pneumatic plant, and the loading by gravity through pipes. Grain is stored in bins or silos. Potash must also be stored in covered spaces, its handling is performed by special plant.

Oil is shipped in tankers which are being built to constantly growing dimensions. This fact and the inflammability of their cargo are of great importance for the siting of handling facilities; loading and unloading is done by pumps. In lieu of fixed quay walls tankers only require short jetty berths. Storage of oil is done by tanks built of steel and, in case of underground installations (air raid precaution) of plain or reinforced concrete. Steel tanks have a diameter of up to 130-ft. and a height of 33-50-ft. For reasons of fire prevention they are arranged in groups. Walls or embankments serve as a defence of these groups against discharging oil. Frequently storage facilities for oil are combined with industrial processing of this commodity (refineries). The

Fig. 9 (above). Transit shed in operation.

Fig. 10 (right). Electric trucks on platform (water side).

## *Fundamentals of Harbour Engineering—continued*

area required by such plant is large. Since oil may be pumped there exists no absolute need for a direct connection of such installations to the water. Pipelines leading to the berths are sufficient. When planning the layout of an oil harbour the total available water front may be utilised very favourably by the skilful distribution of the hinterland and the allotment of one industrial undertaking to each berth.

### GENERAL POINTS OF VIEW FOR PORT PLANNING

Planning and layout of a port will be decided by the natural local conditions and by the hinterland; a special asset is a free port franchise.* The development of a port depends mainly upon the activity of its merchants. Trade will supply the goods; it is for the harbour engineer to plan and build the facilities for handling the goods. In this connection he must ingeniously try to find a common denominator for the diverse requirements of the sea, inland and harbour vessel ; the railway, road vehicle ; the navigator, the port manager, the store keeper, the manufacturer and many others. Generally the most perfect solution from an engineering point of view will also be economically the most favourable.

Berths in a port are arranged upon the principle of the uninterrupted wharfage line or as quays or piers. In the case of limited water frontage and restricted land areas dock facilities of sufficient extent can only be created by the formation of quays or piers projecting into the water. It often happens that a later date piers or quays are built in harbours which originally were built on the principle of an uninterrupted wharfage line. The deep water frontage of a port is such a valuable asset as to make it necessary to accommodate as large a land area as possible by a minimum of water frontage.

Port works are closely connected with the general building work of the town. The general plan of the port should be part of the large scale plan for the development of the town. The general plan by which the port also ensures its future development contains the results of considerations, for the present and future, as to where quay and wharfage facilities and port industries, special installations (e.g. a fishery port), water ways, railways and other main traffic facilities, as distinct from districts for living quarters of the people working in and for the port, are to be located. Close proximity to the town is advantageous to coastal traffic, dispatch of passengers, storage undertakings and, to a certain extent, for the handling of general cargo. On the other hand bulk goods (oil for reasons of fire precautions) may be handled at the periphery of the port. Industrial premises ought to be established at deep water sites only where sea-going ships have to be dispatched continuously at such an installation. Otherwise undertakings of this nature may be located at water areas of lesser depth and will have to put up with transhipment by barge or lighter.

The reputation of the port will depend upon its efficiency which, however, is not necessarily ruled by its size. An indication as to its efficiency may be found in:

(a) average time of a ship in port;
(b) yearly turnover of cargo per longitudinal unit of quay;
(c) yearly turnover per square unit of transit shed.

Unless information arrived at by local experience is available the layout of general cargo quays may be based upon the turnover of 153 tons of cargo per foot run per year (b) and the handling of 8.4 tons of cargo per square yard of shed area per year (c). Preferential service at the port will always be afforded to the deep-sea vessel which demands a quick turn around. Money is earned by the ship when under way and not in port. Fortunately the means of mechanical handling of goods, which in this article have been but hinted at, afford a wealth of ever increasing possibilities. The port engineer should, however, realise that all his endeavours are in vain unless his work is supported by a proper organisation of the port and the intelligent employment of man-power.

*Free ports or " foreign trade zones " afford the possibility of goods being stored, processed and re-exported without being subject to import laws, customs control, certain taxes, etc.

## The Port of Melbourne

### Record Traffic in 1950

The trade of the port of Melbourne during 1950 reached the record total of 7,544,465 tons. It was nearly 600,000 tons greater than the previous record, in 1949, and exceeded by well over a million tons the trade of the last pre-war year, 1938. Oversea imports aggregated 3,984,672 tons, and exports 913,115 tons. Inter-State and State imports totalled 1,997,025 tons and exports 649,653 tons. Compared with 1949, oversea imports increased by 885,599 tons, but there were decreases in the other three categories.

Bulk trade, which amounted to 3,439,567 tons, showed a rise of 1,300,000 tons or 60 per cent. over the 1938 figure. The general cargo handled during 1950, 4,104,898 tons, was 200,000 tons less than that for 1938. Fuel oil imports were only 80,358 tons in 1938, but last year they amounted to 488,029 tons.

### SHIPPING ARRIVALS

Vessels entering the port during 1950 numbered 2,352, of 14,454,515 tons gross, the latter figure being surpassed only once in the 73 years' history of the port. There were 1,308 oversea vessels entering, 1,015 inter-State and 29 intra-State. Although the number of intra-State vessels fell from 106 in 1949 to 29, the gross tonnage decreased by only 15,000 tons.

There was no significant change during the year in the passenger and migration trend. The total, in and out, was 141,222 compared with 141,768 in the previous year.

### PORT IMPROVEMENTS

Considerable use was made of the many port services during the year, and the increased installation of mechanical cargo-handling equipment by the port authority included five new electric level-luffing wharf cranes, and many new mobile cranes and fork lifts. Despite manpower and material shortages, the Trust continued with its port improvement schemes. The major new project undertaken during 1950 was construction of docks at the river entrance, where 28 new berths are ultimately to be provided for oversea shipping. For this work the Trust let a £1,500,000 dredging contract to British and Dutch interests, and Dutch technicians and all necessary equipment were brought from Holland.

### HARBOUR RADAR FOR PORT OF NEW YORK.

The Port of New York Authority has started a six-months' experiment with harbour radar, using an installation similar to that which has been in use at the Port of Liverpool and the River Mersey for nearly two years. At the end of November next, an advisory committee will review the results of the experiment and determine whether a permanent radar installation would be advantageous. Radar scanners have been installed on Staten Island in such a position as to pick up all activity in the harbour channel, and a complete picture of the harbour is shown on radar screens in the station below.

### BRITISH RADIO AND RADAR

In connection with the National Radio Exhibition, which will be held at Earls Court from August 28th to September 8th next, the Radio Industry Council have published for oversea circulation a booklet reviewing British radio, television and electronic equipment, including navigational aids. Where radar is concerned, it is emphasised that this was a British invention entirely and that every major development of it has been British. Ships are now being equipped with British commercial radar at a rate of one a day, and by the end of 1950 nearly 1,200 British and foreign vessels had been fitted.

### PROPOSED SOUTHAMPTON PORT CONTROL STATION

Subject to the approval of the Air Ministry, the Southampton Harbour Board plans to establish a new control station at the top of Calshot Castle. The proposed station will be equipped with the latest radio aids and will work with patrol launches fitted with radar and radio-telephone. Radio-telephone contact will be maintained between the harbour and docking authorities, incoming and outgoing ships, pilots' station and cutters, harbour patrols and the oil installation jetties at Hamble and Fawley. Calshot Castle is the air traffic control centre for R.A.F. Coastal Command flying boats in Southampton Water.

# The Port of Hong Kong

## Efficient Facilities and Modern Navigational Aids

*(Specially Contributed)*

THE excellent natural features of the harbour of Victoria, Hong Kong, are well known throughout the world and its port facilities and rate of cargo handling compare favourably with any other first-class port.

### ADMINISTRATION

The harbour of Victoria, together with the waters of the Colony, is administered by the Director of Marine (Mr. J. Jolly, C.B.E.). He is assisted by an Assistant Director, Port Control (Mr. F. W. J. Skutil) and an Assistant Director, Ship Surveys (Mr. N. Garland, I.S.O., B.Sc., M.I.N.A.) and by a Port Committee consisting of four official Members and the King's Harbour Master representing The Commodore-in-Charge, Hong Kong, together with four unofficial Members nominated by the General Chamber of Commerce and the Chinese Chamber of Commerce. This Committee advises on long term policy, and a Port Executive Committee, representing shipping and godown interests with the Director of Marine as ex-officio Chairman, deals with the day to day problems of the Port.

All Marine administration is now centred in one building on the waterfront which also houses the Senior Port Health Officer and his Staff in addition to the two Branches of the Marine Department.

The Port Control Branch of the Marine Department deals with the entry, berthing and clearance of all ships over sixty net register tons, and all other general matters affecting the safety of shipping and the smooth working of the Port. This includes the Mercantile Marine Office, where ships' crews are engaged and discharged on British Articles, the Registry Office which is concerned with all matters affecting the registration of vessels on the Hong Kong Registry, the Marine Licensing Office with the licensing of 17,000 odd junks and other craft licensed in the Colony, and the entry and clearance of junks and power driven vessels under sixty net register tons, the Lights Office with the establishment and maintenance of Marine Navigational Aids, and a Slipway Staff for the efficient running of some 150 small Government vessels.

The ships' Survey Branch of the Department provides Government Ship Survey services with a staff of highly-qualified officers who undertake, on behalf on British and Foreign Governments, all classes of international survey duties to the standards of the International Conventions and Simla Rules. The services of these Surveyors are available on a 24-hour basis and are called upon by every major maritime nation whose vessels call at Hong Kong.

### FACILITIES OF THE PORT

The Port is well equipped with aids to navigation, both in the approaches and within the Port, and all lights have been re-established since the end of the war with Japan.

Ocean-going vessels with a draught not exceeding 34-ft. can enter by the eastern entrance, and if not exceeding 24-ft. by the western entrance. Each entrance is covered by a Quarantine Examination Anchorage with Port Health Officers' launches, equipped with Radio Telephones, on duty from 0600—1800 daily. This arrangement expedites the granting of pratique and prevents unnecessary movements within the crowded harbour.

Ship to shore communications are provided by three Signal Stations, each manned on a 24-hour basis, and fitted with modern daylight signal lamps which provide coverage for all anchorages within the harbour and its approaches. In addition, Waglan and Green Island Lighthouses operate Signal Stations equipped with Radio Telephones, which enable the first information of all vessels sighted in the eastern and western approaches to be passed to the Port Authorities, Owners and Agents.

The internal security of the harbour and of the Waters of the Colony is maintained by the Marine Division of the Hong Kong Police, which consists of 36 Officers and 360 Men, who man and operate a fleet of 26 Police Launches. All these launches are armed and are in radio telephonic communication with the Control Room at Police Headquarters.

### WHARVES AND WAREHOUSES (GODOWNS)

The Port is well equipped with commercial wharves and piers, the principal ones being on the mainland. Of these the Hong Kong and Kowloon Wharf and Godown Company Ltd., has 10 deep-water berths which can accommodate vessels up to 750 feet in length with a maximum draught of 32 feet. Storage space for approximately 750,000 tons of measurement cargo is available in the Company's godowns, which are equipped with electric cranes and hoists. The Company maintains its own Wharf Fire Brigade, in addition to the usual fire prevention equipment, and for internal security and prevention of theft it has its own Wharf Police.

Messrs. Alfred Holt & Company Ltd. (The Blue Funnel Line) also have their own facilities on the mainland. These comprise two wharves having a total frontage of 1,600-ft. and sufficient depth of water to accommodate vessels drawing 31-ft. Their godowns have storage space for approximately 26,300 tons measurement, and are equipped with electric lifts.

View from the Kowloon Wharves, showing the Star Ferry and Police Piers in Kowloon, with the Railway Station in background.

On the island of Hong Kong the North Point Wharves, Ltd. recently completed the only commercial deep-water berths available to shipping on the island. The quays total 1,223 feet in length and can accommodate vessels of up to 30-ft. draught alongside. Storage space is available for 20,000 tons measurement. At West Point the China Provident Loan & Mortgage Company, Ltd. have godowns with a storage capacity of 110,000 tons and it is proposed to build a modern pier there in the near future.

In addition to these wharf facilities the Government maintains for hire 46 moorings, 17 ' A ' Class moorings suitable for vessels up to 600 feet in length, and 29 ' B ' Class moorings for vessels up to 450 feet in length. Seven of the ' A ' Class moorings are special Typhoon Moorings.

The Port of Victoria is amongst the busiest ports of the world, as is shown by the fact that during the last year nearly 67,000 vessels of 23¼ million net tons entered and cleared ; of these 43,000 vessels of 22¼ million net tons were engaged in Foreign Trade and 23,900 were junks and power-driven vessels of under 60 tons, engaged in local trade and totalling 750,000 tons.

In the last year over 2 million passengers arrived and left the port together with 25,000 who embarked as declared emigrants. Of these passengers 1½ million were arrivals and departures from Foreign Trade vessels, and the remainder were from Local Trade vessels.

## *The Port of Hong Kong—continued*

Panoramic view of the typhoon shelter at Causeway Bay. The Royal Hong Kong Yacht Club can be seen at the extreme right.

### INTERNAL FERRY SERVICES

There are two principal ferry companies, the Star Ferry Company, Ltd. who operate a passenger ferry service across the narrowest part of the harbour, a distance of approximately one mile, from a point in the centre of Victoria to Tsim Sha Tsui at the Southern extremity of Kowloon Peninsula. This company maintain a service for 19 hours per day, and carry approximately 35 million passengers a year.

The other Company, the Hong Kong & Yaumati Ferry, maintain regular vehicular and passenger services between the Island of Hong Kong and the Kowloon Peninsula, with passenger services to outlying districts and islands. This Company carry about 46¼ million passengers, and approximately 750,000 motor vehicles per annum.

### SHIPBUILDING AND SHIP REPAIRING

There are over 150 shipbuilding and repair yards in the Colony, of which all but nine concern themselves with the smaller types of vessel and native craft.

With the general improvement in the position of the supply of steel, new construction on a number of vessels has commenced in the past year, the largest being a 10,000-ton passenger and cargo ship and a 200 feet high-class river steamer. There is wide variety in the types represented in the new work, small self-propelled craft, special aluminium alloy launches, tugs and salvage vessels, ferries for both passengers and vehicles, steel lighters of large capacity and a growing post-war business in ships' lifeboats for export and local supply. As a number of additional inquiries have also been received, there is a distinct possibility of a substantial revival in new building construction.

The repair yards in themselves represent a major industry in the Colony, especially when it is realised that a sea-going tonnage of over 23 million net tons per annum regularly use the port. Repair work is on an international basis with British, Dutch, American, Canadian, Indian, Norwegian, Swedish, Chinese, Burmese, Korean, Philippine and Russian ships making use of the services available.

In 1949, the two largest repair yards, the Hong Kong and Whampoa Dock Company, Limited, and the Taikoo Dockyard and Engineering Company, Limited, which are under European management, docked 510 vessels totalling 1,226,000 gross tons, effecting in addition, repairs afloat, to over 1,440 ships of 6¾ million tons. The facilities owned by these two large dockyards include seven graving docks and five patent slipways, the largest dock being capable of accommodating ships of up to 750-ft. in length. With the completion of the elaborate post-war rehabilitation and modernising programmes which have been undertaken by these two concerns, comprehensive facilities now exist for repair work to hull, machinery and equipment on all types of vessels. Heavy lift facilities are provided by a 100-ton hammer-head crane, and a 150-ton electric " Titan " crane. Licences are held for the manufacture of Brown-Curtiss & Parsons Turbines and Sulzer and Doxford diesel engines. First-class facilities are also available for both towing and salvage services by the Dock Companies and by Messrs. Mollers, Limited, who operate a large Salvage and Towing Company based on the Colony.

The repair figures given exclude the work performed in the Chinese-owned yards of which six are capable of slipping and building vessels up to 220 feet in length. The remaining small yards devote their activities to building and repairing small wood vessels.

It is generally considered that the building and repairing facilities in the Colony are the finest in the Far East, and as an adjunct to these activities there are Ship Survey Organisations of international standing, which include Lloyd's Register of Shipping, British Corporation, the Bureau Veritas, the Norske Veritas and the American Bureau of Shipping.

## Installation of New Light and Fog Signal Equipment

On the re-occupation of the colony of Hong Kong in August, 1945, it was found that all the principal stations had been bombed and subsequently looted, most of the navigational lights being destroyed.

In view of the importance ot these to shipping moving around the coasts of the colony, a special grant of over $2,000,000 was made for the purchase of new equipment, and the opportunity was taken to modernise the whole lighthouse system and to bring it into line with present day needs.

After consultation with various Lighthouse Authorities, a plan was submitted and approved at a meeting held in the London office of the Hong Kong Civil Affairs, at which the Director of Marine and Superintendent of Lights were present. Orders for the new equipment were placed with The Gas Accumulator Company of Brentford; AGA, Sweden; and Messrs. Chance Brothers of Birmingham.

### WAGLAN ISLAND

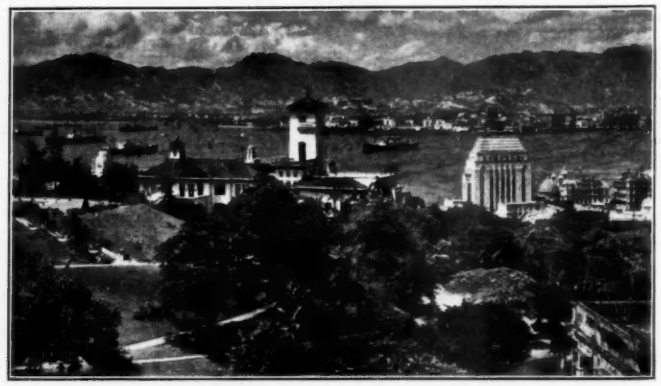
Of the several stations to be dealt with, the most seriously affected and the most important and costly to reinstate was Waglan. On this station an entirely new and up-to-date lighting apparatus has been installed, the general arrangement of which is shown in the accompanying photograph.

The lightsource is an electric incandescent lamp consuming 1,500 watts carried at the focus of a revolving type lens of 375 m/m focal distance. The light character exhibited is a group of two flashes every 30 seconds, and the apparent light intensity per flash equals approximately 1,130,000 standard candles, giving a normal visibility well up to the geographical range of the light.

The equipment is designed to provide semi-automatic service and, to guard against the failure of the lamp or electrical breakdown, an AGA automatic lamp changer is incorporated.

Lighting and extinguishing of the light is controlled by the now well known Sun Valve which, actuated by solar radiation, functions in a similar manner to an electrical relay, but the operating energy is acetylene gas. On the approach of darkness the valve opens and causes the lens to commence to revolve and the lightsource to come into service, while upon the return of daylight the process is reversed.

The lamp exchanger is equipped with two electric lamps for use in succession, so that upon the failure of that in service the second

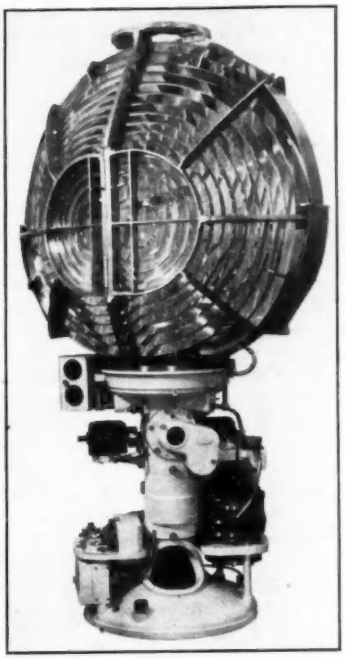


View of the harbour and of Kowloon from the mid-hills in Hong Kong. In the foreground is the tower of the Governor's House.

## *The Port of Hong Kong—continued*

automatically takes its place, the keeper being notified of this changed condition by the system of alarms provided. In the third position on the exchanger there is an incandescent mantle of the type associated with the AGA Dalen apparatus. This stand-by lightsource is automatically brought into service in the event of a complete electrical failure, when both illumination of the lens and its rotation is maintained by acetylene gas.

Electrical power plant for the light and illumination of the keepers' living quarters is located within the lighthouse buildings and consists of diesel driven generators in duplicate, each having an output of 6 k.w. at 110-150 volts.



Waglan Pedestal and Optic.

The fog signal installed at this station is of Messrs. Chance Bros. " G " type superimposed diaphones, half a wave length apart. The signal consists of two blasts in quick succession repeated each minute. The associated air compressors are driven by diesel engines and work at a pressure of 35 lbs. per square inch.

Range of audibility is necessarily governed by weather conditions, but it is expected that the signal will be heard under any conditions at a distance of about five miles.

All the equipment at Waglan came into full service on 20th May, 1950.

### TATHONG POINT

This station is in close proximity to Waglan and it has been considered sufficient to provide here an AGA 200 m/m lantern of the beacon type exhibiting a flashing character, the light intensity developed being sufficient for a range of eight miles.

The old fog bell, which was destroyed by enemy action, has been replaced by a powerful modern fog signal of the AGA electro-magnetic oscillator type. The installation consists of two units, both with a sound pitch of 300 cycles and a character of one blast every 30 seconds.

This device is a relatively new development in fog signal appliances and is now used for the first time in Far Eastern Waters. In its operation, use is made of the frequency of an alternating current to produce sound. Each unit consists essentially of two tuned diaphragms which are vibrated at the required frequency by means of electro-magnets. The tuned note produced is transmitted to the outer air through resonating horns which form part of the assembly.

The apparatus installed at Tathong Point is stated to have a range of audibility of well over three nautical miles and requires an input of electrical energy of about 2.5 k.w. for each unit. Tests already carried out show this type of signal to be extremely efficient, and the range from which it has been heard is considered ample to cover this dangerous area where fog is known to hang for long periods.

### GAP ROCK BEACON

A light and fog signal has also been supplied for Gap Rock, but owing to the prevailing political difficulties regarding the ownership of the Island, neither the light nor the fog signal apparatus has yet been erected, but remains in store at Hong Kong. The Light Equipment is almost identical with that at Waglan and the Fog Signal is also an AGA 4-unit similar to the one supplied for Tathong Point.

**Cape Collinson** is the main concern of shipping entering the port after passing Tathong Point and here again the navigational aids were destroyed and looted during the war years.

At this station has been set up an AGA Dalen light having a 50 litre incandescent burner at the focus of a 500 m/m lens. An automatic mantle exchanger is provided and lighting and extinguishing of the burner is carried out automatically under Sun Valve control.

The dangerous rocks lying on the west side of the Tathong Channel are covered by the reintroduction of a red sector.

**Blackhead Signal Station.** The lantern and tower were found still to exist, and the light has been re-established by the embodiment of an electrical installation, the necessary energy being taken from mains available at the site.

The new apparatus consists of a 500 m/m diameter dioptric lens with automatic lamp exchanger. The light power produced is approximately 22,000 S.C.P. and the character of the light is flashing 1″ + 2″ + 1″ + 6″ = 10″.

A red sector over an arc of 120° has been provided to cover the Cust and Channel Rocks.

**Tung Ku Light** is situated at the approaches to the Pearl River and is an unwatched AGA equipment using dissolved acetylene. The light apparatus consists of a dioptric lens of 375 m/m diameter, at the focus of which is located an open type burner. The character is flashing 0.5″ + 4.5″ = 5″ and the range is stated to be 15 miles.

### KAPSING

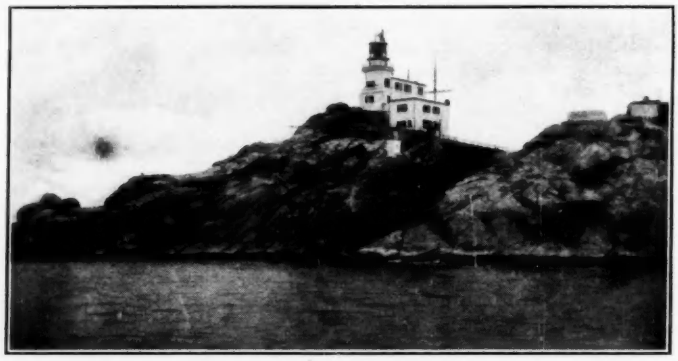
The new light installed here is also a dissolved acetylene equipment designed for unwatched service. The 375 m/m optic has at its focus an open type burner and the character exhibited is flashing 1″ + 4″ = 5″.

In replacement of the old weight driven fog bell which was located at the top of the Island, a modern automatically sounded bell, weighing about half a ton, has been installed at a site near sea level, where it is calculated that it will work at maximum efficiency.

The bell striking mechanism is actuated by $C.O_2$ gas, and the signal is brought into and out of service by a humidity valve developed for the purpose by AGA.

AGA Automatic Lamp Exchanger.

## *The Port of Hong Kong—continued*



View of Gap Rock Beacon.

### GREEN ISLAND

The installation of the new apparatus at this station is not yet completed, but the plant and apparatus has arrived and the work is well in hand.

The light apparatus will consist of a combined electric/acetylene unit in which the normal light exhibited will be electric, the power being obtained from an existing supply; the lightsource will be a 500 watt, 110 volt bunch filament lamp. An automatic lamp exchanger is provided, carrying two electric lamps for use in succession and a 100-litre Dalen incandescent mantle to act as the standby lightsource.

The second order dioptric lens in service at this light before the war is still available and will be used.

With the electric lamp in service, the light intensity developed through the optic is expected to approximate 52,000 standard candles, while the light character will be white, flashing 2″ + 6″ = 8″. The light is expected to be visible from a range exceeding 16 miles.

All other light stations in the colony have been provided with new equipment to meet the increased ranges needed, and to affect general improvements on pre-war standards.

# Dock Labour Disputes

## Report on London Enquiry into Unofficial Stoppages

The Report* was recently published of the Committee set up in May 1950 by the Minister of Labour and National Service under the Chairmanship of Sir Frederick Leggett to investigate the problem of stoppages in the London Docks. The Committee's full terms of reference were:

" In view of the stoppages that have taken place in the London docks, to investigate the problem fully and to consult representatives of both sides of the Port Transport Industry with a view to reporting what steps can be taken to avoid further unofficial action of the type that has taken place during the last three years and has proved injurious to the trade of the country."

The Committee's main findings and recommendatons fall under five headings : the industrial background of the problem ; the activities of the " unofficial " group; the Dock Labour Scheme; the Trade Unions; and amenities in the London Docks, and are summarised as follows:

### THE INDUSTRIAL BACKGROUND

(a) The nature of dock work is such as to provide opportunities for disputes to occur to an extent not found in other industries. In London, the outlook of the casual worker still persists, and is shown particularly in the continuance of restrictive practices, and in the tradition of unquestioning solidarity in strike action. In spite of the benefits which it confers, the obligations imposed upon dock workers by the Dock Labour Scheme have caused resentment and irritation among the men.

*Report of Committee of Inquiry. Unofficial Stoppages in the London Docks. Cmd. 8236. Stationery Office. 1s. 3d.

### ACTIVITIES OF THE " UNOFFICIAL GROUP "

(b) The unofficial Portworkers' Committee have taken every advantage of these circumstances with the object of disrupting the work of the port by unofficial strikes, and otherwise undermining the constitutional methods of the unions.

### THE DOCK LABOUR SCHEME

(c) The Dock Labour Scheme, while providing safeguards against the economic insecurity of the past, has left the organisation of employment much as it was in the days of casual labour. Moreover, the Dock Labour Board has been interposed as a third party between employers and workers, and has thus increased the impersonal nature of their relations. There is not the stable relationship between employers and workers which obtains in industry generally. The Scheme as at present operated should be regarded as only a stage towards a form of organisation which would produce more stable and direct relations between employers and workers.

(d) To this end, permanent employment should be extended as far as possible.

(e) The dual position of members of the Board who are also representtives of industrial organisations has caused difficulties, particularly in disciplinary matters where Board members have been associated with decisions against their own members. There is a lack of recognition of the joint responsibility which is inherent in joint control of the Scheme.

(f) Responsibility for discipline under the Scheme should be transferred from the Dock Labour Board to the joint industrial machinery and the present disciplinary procedure should be changed.

(g) The continuance of unofficial strikes and other unconstitutional action may compel the suspension of the Scheme in London.

(h) Individuals who persistently show themselves unwilling to observe the conditions of the Scheme or who persistently incite unconstitutional action should be dismissed from the industry and dock workers brought to realise that such disciplinary action is essential to the continuance of the Scheme.

(i) Appropriate penalties should equally be introduced for persistent breaches of the Scheme by an employer or by any agent acting on his behalf.

### THE TRADE UNIONS

(j) Friction between the Transport and General Workers' Union and the National Amalgamated Stevedores and Dockers is a source of trouble and closer unity between the two unions is desirable. The Trades Union Congress should consider whether it could help towards this end.

(k) Special measures are required and should be taken, particularly in a large trade union organisation, to retain the lively interest of the members, to encourage their participation in union activities, and to keep them fully informed of the affairs of the industry. There should be a Transport and General Workers' Union publication exclusively for dock workers.

(l) The unions should do more to minimise unofficial action by speedy and vigorous intervention when trouble threatens and by combating the tendency to strike first and think afterwards.

### AMENITIES

(m) Amenities for dock workers in London are totally inadequate, and this has contributed to the sourness of industrial relations in the port. Minimum legal standards in these matters should be extended, or should be established where they do not already exist. The planning and control of amenities should be concentrated under a single authority, and joint welfare committees should be set up as part of the standing joint industrial machinery in the port.

### NATURE OF DOCK WORK

Regarding the industrial background, the report states that there are certain inescapable features of dock work which create almost constant opportunities for disputes to occur in a way which probably does not arise in any other industry. It is not suggested that the nature of dock work is such that frequent disputes and stoppages are inevitable; indeed, given good will and mutual trust, there is ample joint machinery, for settling all differences without interruption of work. The fact remains that there are greater op-

## *Dock Labour Disputes—continued*

portunities for disputes to occur and for the activities of deliberate trouble-makers than in most other industries. This is the more important because of the vital part played by port transport in the economy of this and many other countries, which makes it an ideal target for disruptive activities. These factors no doubt go far to explain the fact that large ports in many countries tend to be notorious centres of industrial unrest.

Almost all dock work in London is paid by the piece. A great variety of cargoes is handled, and a rate must often be agreed for each commodity. Although there are in most trade groups in the port agreed schedules of rates the number of commodities is so great that differences are always liable to arise in interpreting or applying the schedule in any given case. Claims for increases on agreed rates may be made according to the method of stowage, the state of the cargo after a voyage, or the handling facilities in the hold, and all such claims must be settled as they arise by " spot settlements." In warehouse work (i.e. the landing, stowing in the warehouse, and subsequent delivery of cargo), it has not been found possible to agree a schedule of piece-rates, since the distance which the cargo has to be moved varies constantly, and even where cargo and distance are comparable, facilities for handling vary from one wharf to another. The necessity for agreeing frequent variations in payment is not peculiar to the docks industry, but in factory production there is not the same variety of circumstances nor the same range of materials to be handled.

### PERSISTENCE OF THE CASUAL TRADITION

Where a dispute arises about payment for work, it is normally provided in industrial agreements that work shall continue with the option of resort to time-work. Time-work, however, has come to mean in practice a serious slowing up of work, which is particularly damaging to the shipping employer, to whom a delay in the turn-round of shipping usually means extremely heavy added costs. Negotiations for increased rates are too often characterised on the men's side by the stopping of the job, in defiance of the advice of their union representative or of a decision arrived at jointly by employers and union representatives through the constitutional machinery. While the persistence of the casual tradition is important in accounting for recalcitrance in negotiations, it must also be remembered that many dock workers are liable as soon as a job is finished to find themselves working for another employer, perhaps in a different part of the docks, and men in this position often feel that negotiations while they are still doing the job in question are likely to be more satisfactory from their point of view than negotiations after the job is finished.

The fact that employers often agree to rates to suit their own individual circumstances, without regard to the effects on the industry generally, tends to weaken the authority of the negotiating machinery and makes it difficult to resist unreasonable demands at other times. When for various reasons there is individualist action among employers, it is to be expected that there will be opportunist action by workers. Even though such action by employers may sometimes be due to the heavy cost of delay, when in the face of pressure they feel they have no alternative to giving way, the normal negotiating machinery is thereby weakened.

### CONTINUING FEAR OF REDUNDANCY

Another legacy of the constant struggle for work in the days of casual labour is the continuing fear of redundancy, which lies behind the dock workers' resistance to mechanisation and reduction of manning scales, and to changes in working rules, customs and practices. Restrictive practices may not in themselves have caused a large number of stoppages, but any attempt to remove them meets with the strongest opposition, and creates an atmosphere in which disputes are likely to occur. It is the Committee's impression that many of the men themselves realise how short-sighted it is to persist in observing working rules which are completely out of date, and feel uncomfortable when they are obliged to do a job by inefficient and time-wasting methods, or to refrain from doing it at all, instead of tackling the work in a sensible way. It is only fair to refer here to allegations by representatives of the workers that the turnround of ships is sometimes delayed by the action of the employers themselves, and that the men consider this to be a restrictive practice.

Under conditions of casual labour, dock workers developed over the years a strong tradition of solidarity in strike action—the tradition of " one out, all out." The presistence of this tradition in changed circumstances is an important part of the explanation of unrest in the docks in recent years. It appears to be incredibly easy to bring dock workers out on strike. In the words of one witness, himself a dock worker: " All that was needed was for a man to go round the docks shouting ' All out ' and waving the men off the ships, and out they would come." Many dock workers, themselves firm supporters of constitutional methods and resolutely opposed to the activities of unofficial elements stated frankly that it was too much to expect of the average dock worker that he should remain at work when his mates were out, irrespective of his opinion of the merits of the dispute. He was quite likely to join a strike without even inquiring about the reasons for it. Nor could he be expected, if allocated to the job, to take the place of one member of a gang who had downed tools while the rest of the gang were prepared to continue work. In this way, one or two men, by stopping work, can leave the gang short-handed and unable to continue. If there are a number of gangs working the various holds of a ship, it will often be impossible, once work has stopped in one of the holds, to continue work beyond a certain stage in any of the others, as this would effect the trim of the ship. As working rules often preclude the transfer of gangs from one hold to another. the stoppage thus spreads. The daily assembly of large numbers of men on the call-stands makes it easier for the example of a few men to sway the rest. If one or two men, in an effort to start a strike, refuse to go across to where the foreman is calling men off, many others will immediately be reluctant to do so, and thus all the elements of a large stoppage are created.

Dock workers still form a narrow and tightly knit community, both at work and to some extent in their home areas. The most powerful factor in causing many dock workers to give support to unofficial appeals for strike action is their overriding fear of being labelled blacklegs and incurring unpopularity or ostracism from mates with whom they will in all probability have to work for the rest of their working lives. The fear of ostracism is not confined to the place of work and many men fear that they, their wives and families, will be made to suffer in their social contacts if they take a stand against unofficial strike action.

One other factor should be mentioned in describing the influence of the past. In the days of casual labour, it was common practice for dock workers, after a period of good earnings or of exceptionally arduous work, to take a rest for a day or two. This was the pleasant side of a bad system. The personal freedom and independence which it meant are still precious to the dock worker, and he has not taken kindly to their drastic curtailment under the Dock Labour Scheme.

### EFFECTS OF THE DOCK LABOUR SCHEME

There is no doubt that dock workers firmly support the Dock Labour Scheme, in the sense that they have no desire to return to pre-war conditions and would be opposed to any change which would take them back to those conditions. This, however, does not prevent the operation of the Scheme from causing a certain amount of dissatisfaction. The Scheme confers substantial benefits upon the men. In London, it has confined employment exclusively to registered men; it provides for a guaranteed weekly wage and payment of attendance money at times when no work is available. These benefits involve corresponding obligations backed by disciplinary sanctions. The Dock Labour Board has power to impose through its local agents the penalties of disentitlement to payments under the Scheme, suspension from work without pay for a maximum of seven days, or outright dismissal.

Full employment has tended to disguise the benefits of the Scheme, and to throw into prominence the obligations which it imposes. Some of the men, who always managed in the days of casual employment to get the more lucrative jobs and to earn high wages, stood in little need of the benefits. Before the war it was possible for many men to confine themselves largely to the work of their choice by taking a day off when no ships of their particular line were being worked, and returning when work restarted. Under the Scheme, a man may take a day off only if he has ob-

## *Dock Labour Disputes—continued*

tained previous authorisation from the Board's local manager; otherwise he must attend the call. At the initial, or free call, he need not take any particular job. If, however, he fails to obtain employment on the free call, he must then report to the Board's local control point where he is obliged to accept any job to which he is allocated. Whether he accepts a job on the free call with an employer other than his preferred employer, or whether he is allocated to such a job by the local manager, he is in most cases obliged under continuity rules to continue at that job until it is finished, and is prevented from leaving it meanwhile for any other job. During this time, he may well miss the opportunity of re-employment with his preferred employer.

The Port Continuity Rule is an industrial agreement concluded in 1944 between employers and Unions in London which provides, with exceptions in certain circumstances and for certain categories of workers, that " every port transport worker engaged in the discharging, loading or ballasting of a vessel, in delivering cargo to, or receiving cargo from, a vessel, is entitled and is required to complete the work for which he is engaged and his book of attendance cards must be held by the employer until the work is in fact finished." The Port Continuity Rule and the stevedores' continuity rule are not themselves part of the Scheme, but breaches of these rules are liable to discipline under the Scheme because the Scheme obliges every dock worker to " carry out his duties in accordance with the rules of the port or place where he is working," and continuity rules are regarded as " rules of the port or place " for this purpose.

Thus, the provisions of the Scheme, coupled with the operation of continuity rules, mean that it is no longer possible for the men to pick and choose from the available work to the same extent as they could formerly. There is much resistance among some of the men to these limitations upon freedom of choice.

Apart from any question of keeping to the better paid jobs, there is no doubt that the obligation to show for work every day, except when excused by the Dock Labour Board, is a cause of irritation and of some backward-looking to the days of casual employment. The plain fact that a system which permitted men to take time off at will would be quite irreconcilable with the benefits conferred by the Scheme does not prevent some feeling of unrest at this curtailment of freedom.

# Off-Site Wharf Construction

## New Method adopted at the Port of Melbourne

SHORTAGE of skilled manpower has made it necessary for engineers of the Melbourne Harbour Trust to use initiative and enterprise in making use of new techniques in wharf construction. They have now pioneered the system, in Australia, of the construction of wharf superstructures off-site. Reid Street Pier, Williamstown, has been built by this method, and work of a similar nature is to be undertaken at South Wharf and Appleton Dock. Orthodox wharf construction in situ, beam and slab, does not now feature so prominently in Port of Melbourne projects.

When the 40-ton diesel electric floating crane, " Endeavour," was designed and built by the Melbourne Harbour Trust for the handling of heavy cargo, means also became available for construction of wharves and piers by a method which could not have been contemplated previously.

Over a period of more than 20 years it has been found that the best wharf for Melbourne conditions was provided by the construction of reinforced concrete superstructures comprised of beam and slabs resting on timber piles.

This type of work was done on the site, in timber forms supported from the piles. This method involved considerable labour in setting up forms and reinforcement over the water, on staging fixed to the piles.

All but the exposed upper surface of each slab had to be formed in suitable moulds, and this involved both expenditure and delay, as the casting of a superstructure could proceed only as the forms became available from earlier sections of the work.

### PRE-CAST SYSTEM OF CONCRETE PLATES

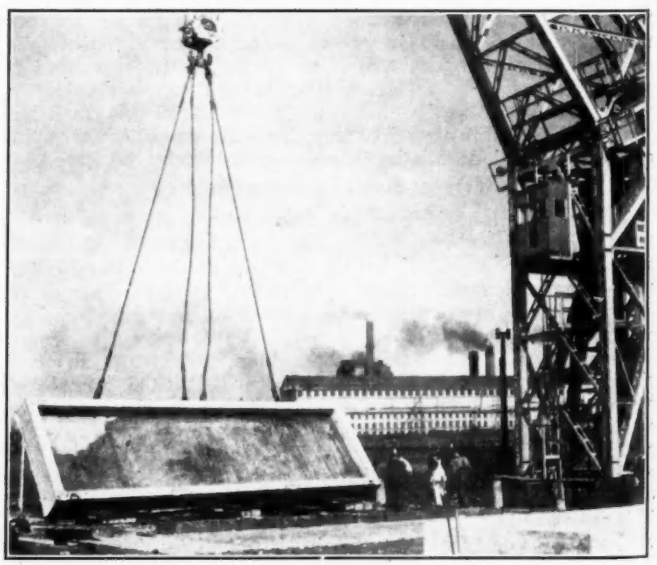
In 1948, when the Commissioners decided to proceed with the reconstruction of Reid Street Pier, Williamstown, plans were prepared for this work using reinforced concrete plates 33-ft. long, 10-ft. wide and 8-in. thick, stiffened on the edges by beams 2-ft. deep and 10-in. wide.

These slabs were to be precast on the banks of the River Yarra, transported by means of the floating crane, and placed on previously driven timber piles cut off to the required levels.

Tenders were invited for the manufacture, supply and delivery of 67 precast reinforced concrete plates. The specification provided that they would be manufactured in accordance with drawings supplied by the Trust, at a site provided by the Commissioners and prepared by the Contractors on the east bank of the River Yarra, near Williamstown Short Road.

All cement and reinforcement was to be supplied by the Trust from stocks purchased overseas under port improvement plans.

Setting up formwork and reinforcement for constructing a concrete wharf slab, upside down, at Newport basin.



The Trust's 40-ton floating crane turning over a precast wharf slab after 21 days' ageing, prior to loading for transport to Williamstown.

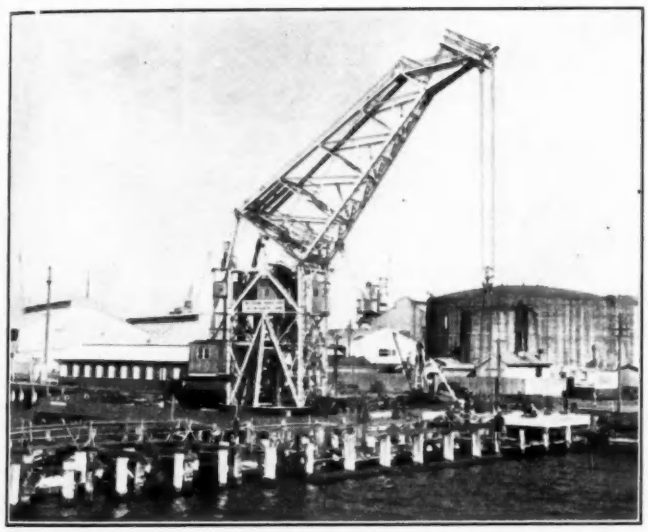
## *Off-Site Wharf Construction—continued*

The contractor was required to level the casting site and construct ten beds on it, each 40-ft. long and 12-ft. wide, of concrete 4-in. in thickness, reinforced with No. 655 BRC fabric, and with all edges thickened to 6-in. over a width of 2-ft. On these beds he was required to cast the wharf plates upside down, so that formwork would be necessary only for the sides of the beams. This work was carefully supervised by the Trust and carried out by Garrett Constructions, who played no other part in the project.

### SLABS TURNED AND PLACED BY FLOATING CRANE

The substructure at Reid Street Pier, consisting of bents of five timber piles at 10-ft. centres, with centrally placed pairs of raking piles, was driven by the Trust. When the slabs cast by the contractor were aged 21 days, they were turned over by use of the 40-ton floating crane and special gear provided by the Trust. To ensure that the edges of the slabs were not damaged, suitable beds of old motor tyres were used to support each slab as it was rolled on its edge.

Four of these slabs, each weighing about 25 tons, were then loaded on to the deck of the floating crane and conveyed to the site of the pier. There they were lowered on to the carefully prepared pile heads, and after being bolted together through precast holes in the side beams and to the pile heads, through the Trust's standard cast steel cleats, holes formed on the edges of slabs over the positions for pile heads were filled with a grout of cement and sand to key the whole structure together.



The floating crane placing concrete wharf slabs on turpentine piles at Ried Street Pier.

View of completed wharf at Williamstown.

### FENDERING PROTECTION

External fendering of 12-in. by 10-in. ironbark was then fixed to protect the concrete from contact with shipping, and the surface finished with a layer of bitumenous concrete. This was intended to cover irregularities in the joints between slabs, but with the tolerances specified the slabs fitted together so well that this surfacing could have been omitted.

This method of wharf construction proved so successful that it has been adopted in the extension of the wharf at No. 30 berth, South Wharf. Here the slabs have to support crane tracks for 7½-ton grabbing cranes, and they weigh up to 40 tons.

Similar construction methods are being used for 3,500 lineal feet of wharf at Appleton Dock, where precast reinforced concrete slabs will be used to carry the wharf apron railway tracks and crane tracks.

The fixing of the rails will be accomplished by stud welded fastenings fixed to plates secured by hook bolts, cast into the top of the slab superstructure.

### ADVANTAGES OF SYSTEM

Apart from the saving effected in labour and material due to the wharf superstructure being cast ashore, off-site, the method has the advantage that the wharf superstructure may be precast and stored. When dredging and pile driving operations are well in hand, it can then be erected in a fraction of the time required under construction on site.

This method, developed by the Trust's engineering staff, can only be used where there are suitable lifting facilities available. The 40-ton floating crane already referred to is proving invaluable in this regard.

## Port of Quelimane Improvements

The Government of Portuguese East Africa has let a contract for the construction of wharves at the Port of Quelimane, the capital of the Zambesi Province.

The town is the terminus of a railway line running in a north-westerly direction, and in addition, a net-work of roads connects it with Nyasaland and Northern and Southern Rhodesia. There is also an airport, from which there are weekly connections with Lumba, Nairobi, Dar-es-Salaam, Beira, Lourenco Marques and South Africa. These communications, together with the ports in Portuguese East Africa, belong to the Government and are run as one organisation.

At present there are no facilities in Quelimane for ocean-going ships, which therefore have to anchor in the stream and load from, or discharge into, barges which unload at the existing small stone or timber jetties.

The new wharves will be about 400-ft. long and 50-ft. wide, and able to accommodate a ship on both sides. They run parallel with the river bank and are connected with the shore by a curved approach, about 280 metres long, partly a reinforced concrete structure and partly an earth embankment, which will give road and rail access, and will also carry cranes, but there will be no sheds. These will be provided in the railway goods yards at the end of the approach. The depth of the water at low tide will be about 21-ft.

The channels giving access to the port are well equipped with navigational aids, which afford the maximum safety to ship calling, and at high tide will allow passage to ships drawing 24-ft. The main export from Quelimane is copra, but considerable quantities of other tropical produce are also handled. The main imports are general merchandise, agricultural machinery, vehicles and railway material. With present facilities, loading and discharging of cargoes is cumbersome, and freight and insurance accordingly high.

The contractors for the works are Christian & Nielsen, of Lourenco Marques, and the new wharves should greatly assist in the development of the Zambesi Province. Work was commenced in September, 1950, and is due for completion during 1952.

# Model Studies of Apra Harbour

## Carried out by California Institute of Technology in Collaboration with United States Navy Bureau of Yards and Docks

ROBERT T. KNAPP, Director.

*(continued from page 14)*

**NORTH-WESTERLY WAVES AND E.N.E. CURRENTS.**

Since waves from the north-west are more or less normal to the direction of the current, they were less distorted than in the above tests; nevertheless there was considerable overtopping, despite the diminution of the imposed wave height by the current influence. Again breakwater D was selected for the more detailed examination, although very little difference could be established in the behaviour of any of the breakwaters. The photograph (Fig. 23) shows that the current assists in reducing the disturbances within the harbour.

**SOUTH-WESTERLY WAVES AND E.N.E. CURRENT.**

As would be expected, the greatest calming effect on the harbour disturbance arising from south-west seas occurs with the head on current from the north-east. Off the Calalan bank the wave pattern suffers great distortion.

**OVERTOPPING.**

Since the foregoing tests with breakwater heights of + 18 feet above M.L.L.W. all showed overtopping, further tests were undertaken for various heights up to + 32 feet. Even with the latter height, overtopping occurred along the Calalan bank. The contours near station 65, the narrowest part of the bank, rise with a slope of 50 per cent., and moreover show a natural cavity in the otherwise almost uniform run of the slope (Fig. 13). The breakwaters PRO, A, D and E, change their line bearing about station 73 + 16, forming an angle between the two alignments of 165 degrees on the seaward side. Breakwaters B and C are straight without any dog's leg breaking the continuity. But the tests showed that all breakwaters were subject to overtopping at or near this narrow portion of Calalan bank, and it was especially severe with north-westerly typhoon waves. This is to be noted in photograph, Fig. 24, of the breakwater D which, in this case is + 26 feet high. Since all the breakwaters, those with unbroken alignment and those with a concavity on seaward face, presented the same overtopping features about the same chainage stations, it was concluded that the overtopping was due to the steepness and concavity of the bank at station 65 or thereabouts.

**CONCLUSIONS.**

(1) Any breakwater constructed to a depth of about 45 feet at the southern tip of Calalan bank will give approximately equal protection to the harbour.

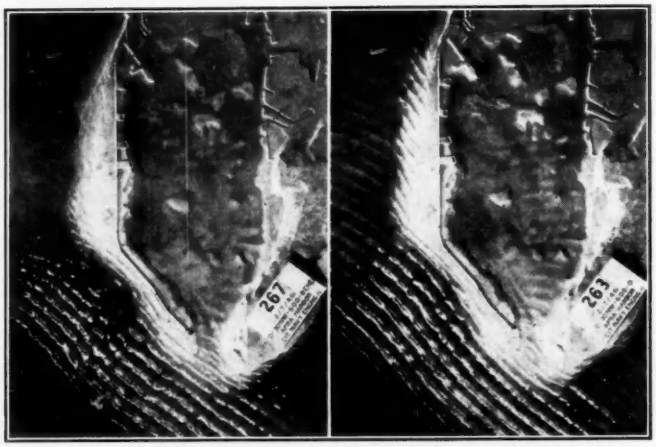



Fig. 23. Effect of current on disturbance pattern with breakwater D. North Westerly waves 30-ft. high, 600-ft. long. Left, 8-knot current. Right, no current.

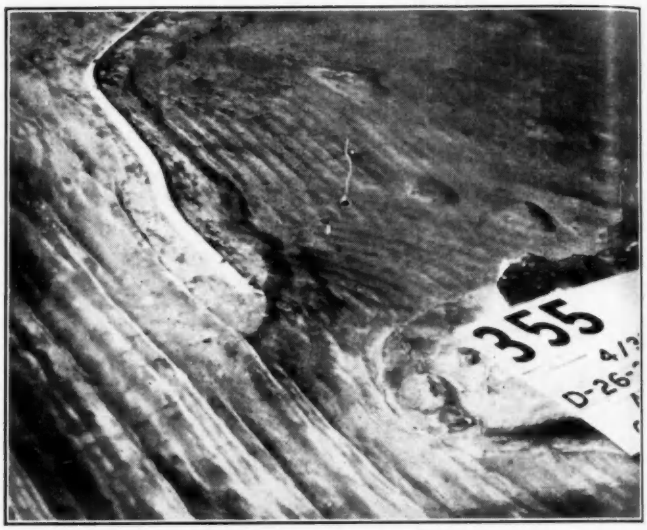



Fig. 24. Overtopping of breakwater D (26-ft. high), north-westerly waves 30-ft. high, 1,200-feet long. Note the crests in the harbour almost parallel with wall.

(2) The location of the breakwater terminus does not significantly alter the disturbance pattern since the effective harbour control is the natural channel between Orote Island and Calalan bank.

(3) A breakwater located along the harbour side of Calalan bank will receive greater protection from the ocean waves than one located in the centre or near the ocean edge of the bank.

(4) Typhoon or severe storm waves from the west and north-west will overtop, at times, any breakwater of 32 feet height along Calalan bank. This overtopping will be especially severe near the narrow part of the bank.

(5) Ocean currents from east, and east north east, reduce the disturbance inside the harbour regardless of the direction of approach of the waves.

(6) The stub breakwater is ineffective against all imposed conditions.

(7) The spur extension of breakwater C is effective against north-westerly waves, but with south-westerly waves it acts to increase the disturbance in the harbour entrance. Westerly and north-westerly typhoon waves overtop the spur at its intersection with the main breakwater.

**THE SHAPE OF BREAKWATER HEADS.**

It was decided to test the relative efficiency of six selected types of breakwater heads (Fig. 29). To do this, a model of plywood and concrete to an undistorted scale of 1/480 was constructed. The model contained the last 1,000 feet of the breakwater wall and the topography of the Calalan bank, the deep water entrance, and the rocks about the Orote Point. The breakwater D was made an integral part of the model to station 103 + 00 (Fig. 13). The selected heads D, F, G and K (Fig. 29) are essentially variations of the same general shape, and removable interchangeable sections were used. Waves in the tests were fixed at 30 feet high, and 600 and 1,200 feet long.

Preliminary tests were made by direct observation, and still photographs in pairs—one, in plan, vertically, and the other

## *Model Studies of Apra Harbour—continued*

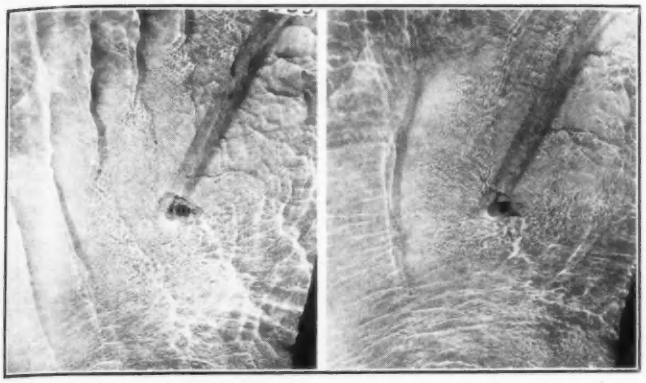


Fig. 25. Plan views of run with terminus D, westerly waves 30-ft. high, left 600-ft. long, right 1,200-ft. long.

obliquely, as shown in Figs. 25 and 26. To assist in the final investigation, motion pictures were taken at 32 frames per second, which gave a two to one apparent reduction in wave velocity when projected at the normal speed of 16 frames per second. The head D, which seemed to be the more feasible, was used as a standard of comparison. An ingenious innovation in this connection was to shoot the performance of D with one half of the film masked. The film was then replaced as original, and the other heads were photographed in turn on the second unused half of the film under corresponding wave conditions.

### WAVE HEIGHT MEASUREMENTS.

The apparatus, and the method of wave height measurement employed, were developed by the California Institute of Technology and supplement the qualitative results of the photographs. This method consists essentially in measuring the quantity of electrical current flowing between two parallel wires projecting vertically downwards through the water surface. This parallel wire construction is the wave height measuring element (Fig. 27). Within limits, when a constant voltage is impressed across such an element, the amount of current flowing will be proportional to the amount of wire surface exposed to the water, and hence, if the wires are stationary, to the elevation of the water surface. The basic principle of operation is that the current is determined by the resistance of its path through the water. If the current is to be nearly proportional to the immersion of the element, it is necessary that the resistance of the rest of the circuit be small compared to that of the water path. This is required because a constant voltage is applied to the wave measuring elements in series with other electrical components. In order to eliminate end effects and so approach two-dimensional conditions as nearly as possible, the immersed ends of the wire are insulated. The diagram of the electrical circuit is shown in Fig. 28, for each of the conductivity elements.

Alternating current was used to prevent the decomposition of the water, and to prevent the thermal formation of bubbles of water vapour; the current density was kept as low as possible, that is, below 0.05 amperes per square inch of immersed surface

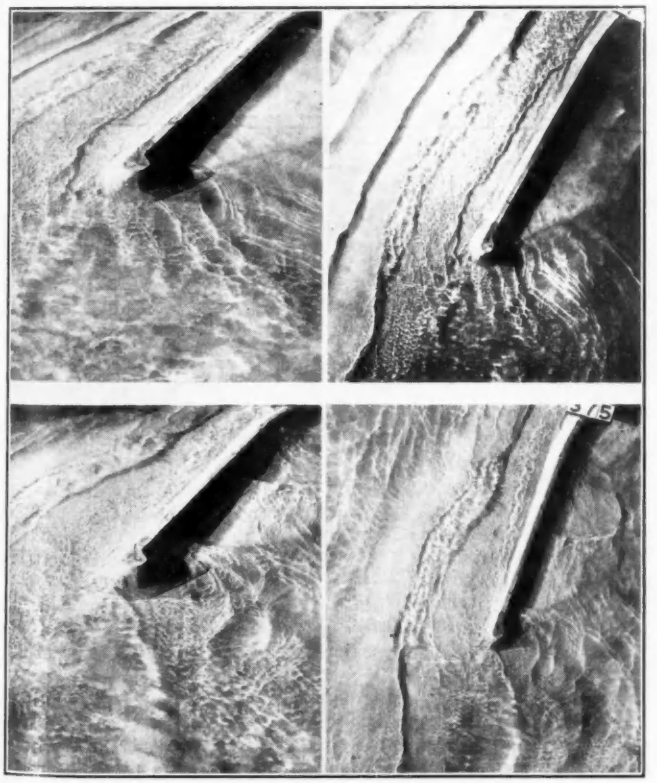


Fig. 26. Simultaneous oblique and vertical views of D breakwater, northwesterly waves 30-ft. high, top 600-ft. long and bottom 1,200-ft. long.

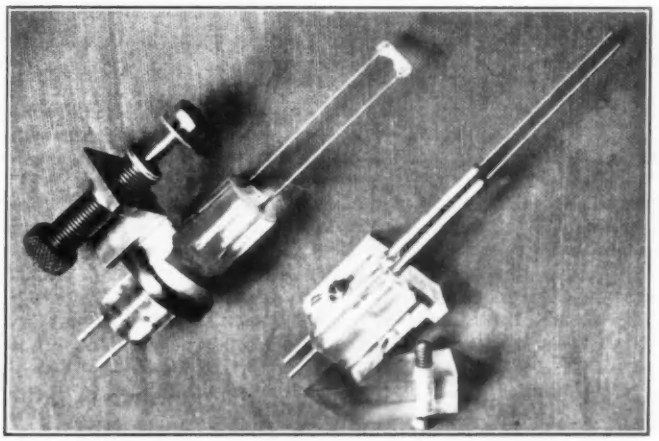


Fig. 27. Wave height measuring elements (left) gold plated; (right) platinum.

area. Of the two types of conductivity elements (Fig. 27), the upper gold plated element was that mostly used in the tests. The lower illustration, a platinum type, was a later design. The adjustment of the deflection sensitivity of one element relative to that of the others is accomplished by varying the sensitivity control in the particular circuit. The correct settings are obtained by changing the submergence of all of the wave measuring elements by the same amount and by then setting the controls to obtain the same deflection with all of the galvanometers. The continuous oscillographic record of the wave motion from the complete system of stations is shown in 16 wavy lines traced across the photo paper, upon which timing lines of 30 seconds interval are drawn.

### CONCLUSIONS.

Neither photographs, motion pictures, nor wave height measurements when examined and analysed showed any decided advantage for any one of the types. They all appeared to give an equal response under similar wave conditions. However, under closer examination, the two features which were evident, though only slightly traceable, were such as might have been deduced without tests. The first was that those breakwater heads having a projection seaward of the wall face, such as F and G, were not so favourable to entrance conditions as those with prominences to the lee of the harbour wall face, such as D and K. The second point was that the wave lengths used in the tests were of a much greater order of magnitude than the changes in the head shapes and, as may reasonably be expected, only those obstructions of a close relative order of magnitude to the wave length would register significant behaviour differences, hence the faint variations in the resulting analyses.

## *Model Studies of Apra Harbour—continued*

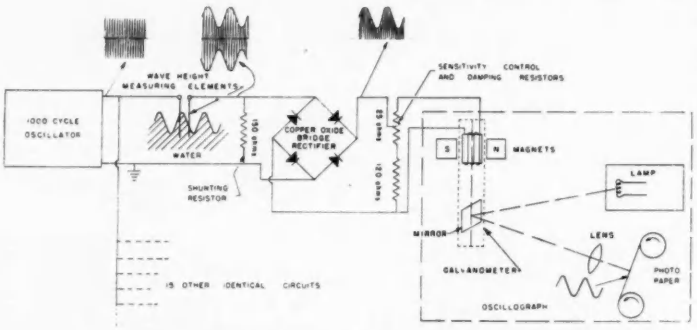



Fig. 28. Schematic diagram of wave height measuring circuit.

The locations of the wave height measuring stations are indicated by the small circles to the right in Fig. 29. There are three rows each parallel to the centre line of breakwater, the near rows 140 feet from it and the inner rows 140 feet apart. The stations on each row are 160 feet apart. The diagrams as drawn do not give a true impression of the wave disturbance. It is better to consider the offing heights separately as indicative of the shoaling effect of the tip of the Calalan bank. On the harbour side the even numbered row and the odd numbered row should also be considered separately. It will then be seen that the same general pattern is common to all with but variation of the extremes. Many similar graphs were made of different wave-lengths and sea direction, and of these the type D showed the more favourable behaviour. A point worthy of note is that when the wave length is increased to 1,200 feet with the same height of waves, the wave height disturbances within the harbour are increased 50/60 per cent.

The head of the breakwater is in about 30 feet depth of water, and stations 2, 3, 4, 5 and 6 are in water depths of about 30, 40, 45, 55 and 45 feet respectively. From the table below, it will be noted that with a wave length of 600 feet there is a considerable difference in the behaviour about the head, dependent upon the direction of the waves and naturally the screening effect of the lip of the reef particularly noticeable at station 6 in a north-westerly sea. The increase of wave length to 1,200 feet shows that the direction of travel of the wave front does not affect the degree of the disturbance about the head.

| Disturbance per cent of imposed wave height | | | | | Wave | | |
|---|---|---|---|---|---|---|---|
| Stations | | | | | Height | Length | Direction |
| 2 | 3 | 4 | 5 | 6 | feet | feet | of origin |
| 38 | 64 | 77 | 72 | 122 | 30 | 600 | Westerly |
| 62 | 122 | 104 | 123 | 152 | 30 | 1,200 | Westerly |
| 47 | 84 | 55 | 70 | 40 | 30 | 600 | North-westerly |
| 67 | 123 | 105 | 124 | 152 | 30 | 1,200 | North-westerly |

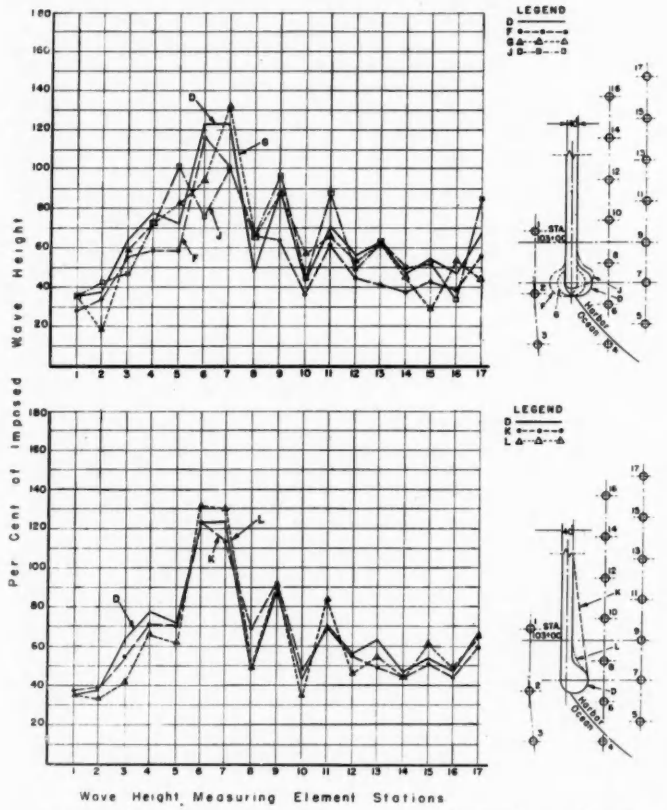



Fig. 29. Effectiveness of termini as measured by maximum disturbances, westerly waves 30-ft. high, 600-ft. long, M.L.L.W.

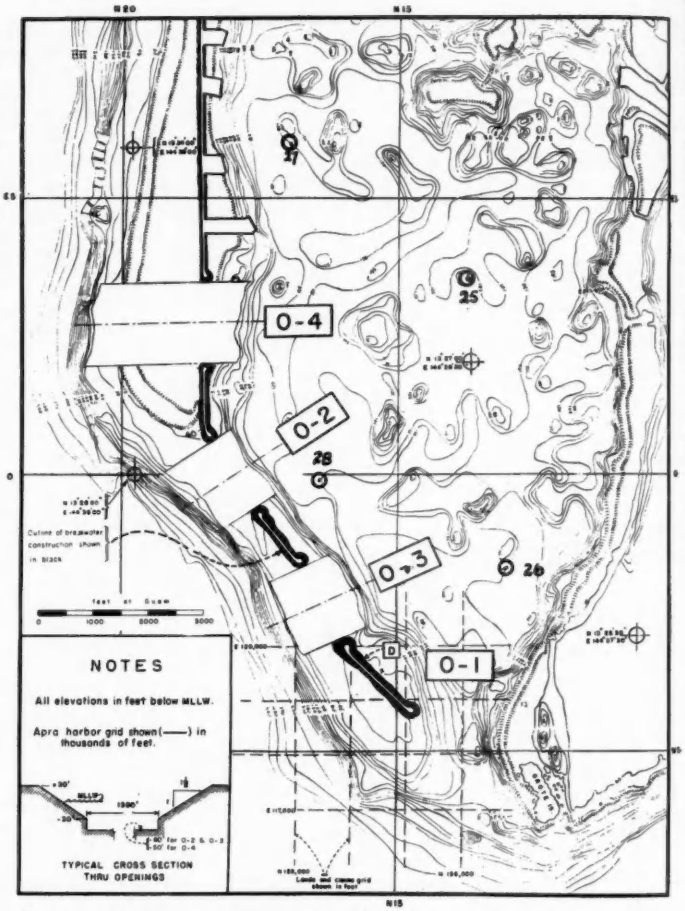



Fig. 30. Comparison of alignment of alternative outer harbour entrances 0—2, 0—3 and 0—4, and existing entrance 0—1.

### EFFECT OF ALTERNATIVE HARBOUR ENTRANCES.

Although there was no call for the investigation of the effect on the harbour disturbance from an entrance, or entrances, located in the line of wall other than that between Orote Point and the tip of the Calalan bank, the Laboratory took the opportunity to carry out tests in this respect. It was a fortunate decision, for irrespective of harbour topography, it presented generalized patterns of disturbance features engendered by the location of the harbour entrance in various parts of a harbour wall, principles applicable to any harbour.

The energy of the entering seas we know to be proportional to the product of wave length and wave height squared ($E \propto w\,l\,h^2$), so that as the wave ends expand in spreading out over the harbour surface the average energy per unit length of crest will decrease as the wave front advances. Thus in a harbour of approximately uniform depth, where the wave length remains almost constant, the wave height will decrease as the square root of the expansion

## *Model Studies of Apra Harbour— continued*

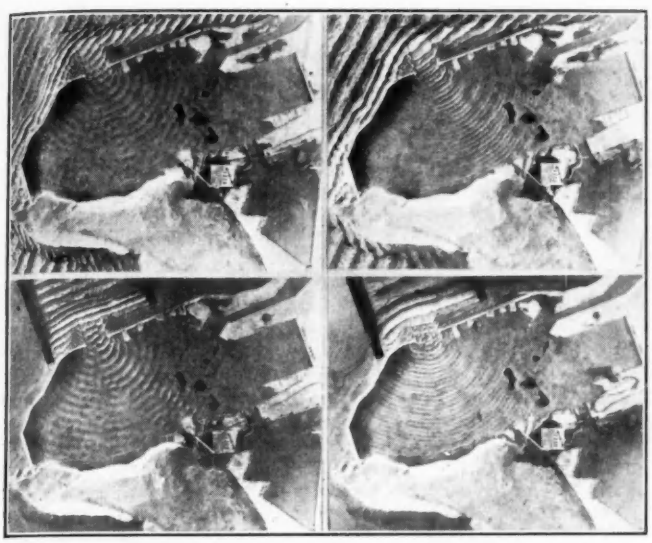


Fig. 31. Disturbances with entrance 0—4. Waves 30-ft. high, left 600-ft. long, right 1,200-ft. long, upper, north-westerly, lower northerly M.H.H.W.

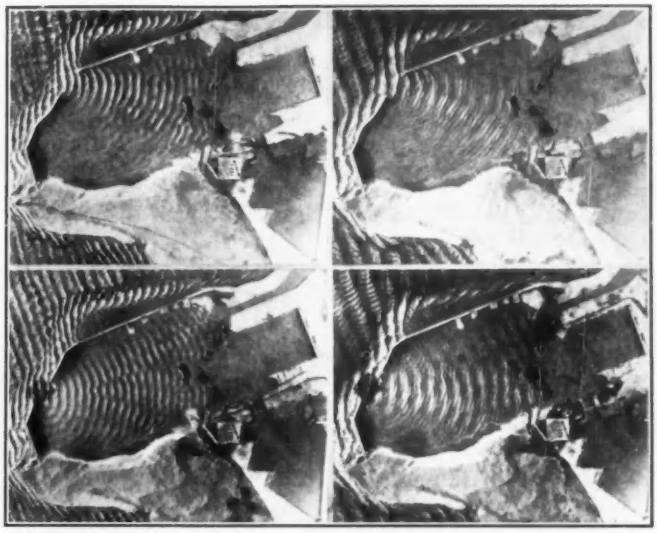


Fig. 32. Disturbances with entrance 0—2 (upper) and entrance 0—3 (lower). Westerly waves 30-ft. high, left 600-ft. long, right, 1,200-ft. long M.H.H.W.

ratio. Therefore, in theory, the entrance should be located and oriented in that part of the wall which allows of the greatest unrestricted expansion of the entering waves, assuming the wave front to expand in a series of semi-circular arcs. In the Apra harbour such a point is situated in Luminao reef, between stations 10 and 20, in the approximate middle of the uniform depth zone.

### LOCATION OF ALTERNATIVE ENTRANCES.

The new entrances tested were as shown in Fig 30, with the original entrance and other entrances closed. The depths of the channels were 60 feet for entrances 0-2 and 0-3, and 50 feet for 0-4 below M.L.L.W. The wave disturbances in the harbour were measured, as before, by the conductivity elements at the stations marked by numbered circles (Fig. 33), in which the areas of primary usage are covered by stations 14, 20, 22 and 6, and the outer harbour by stations 25, 26, 27 and 28. Measurements were made also at many other points, but the above are sufficient for our purpose. In all these tests the model shoals remained as existing. The waves were 30 feet high, 600 and 1,200 feet long from the west and north-west, and for entrance 0-4 alone, from the north. The records at Guam of the Fleet Weather Central show that the most severe storms are from the west and the most frequent storm waves from the north-west.

The photographic records of the tests, of which Figs. 31 and 32 are representative, show most interesting distributions of wave disturbances. The tests were more concerned with areas of usage, such as the fitting-out quays and repair basins at the head of the harbour, and unfortunately only four wave height measuring stations were located in outer harbour. Examination of the photos, however, shows generally that the expansion of the waves as they fan out in the forward progress occurs more rapidly at the extremities, where the wave height is noticeably reduced, whereas in the centre and in the direction of the original propagation the wave height is reduced more slowly. Analysis of the wave reduction figures in Fig. 33 supports this conclusion. For example, with the entrance 0-1 and a westerly wind, at station 25, almost in the axis of the entrance and harbour (W. to E.) the wave height is 7% greater than at station 28, which lies to the flank and is little more than half the distance of station 25 from the entrance. Similarly with the entrance 0-4 and northerly waves at station 25, which is slightly east of the axis of the northern entrance, the wave height is 7.7% greater than at station 27, which lies to the east flank and is only 3/5ths of the distance of station 25 from the entrance.

Another point which may be traced on the photographs is the bias which the direction of the imposed wave front in the offing gives to the harbour wave front despite the directing influence of the entrance channel. The tabulated results of the tests showed that the entrance 0-4 was the more satisfactory. The comparative

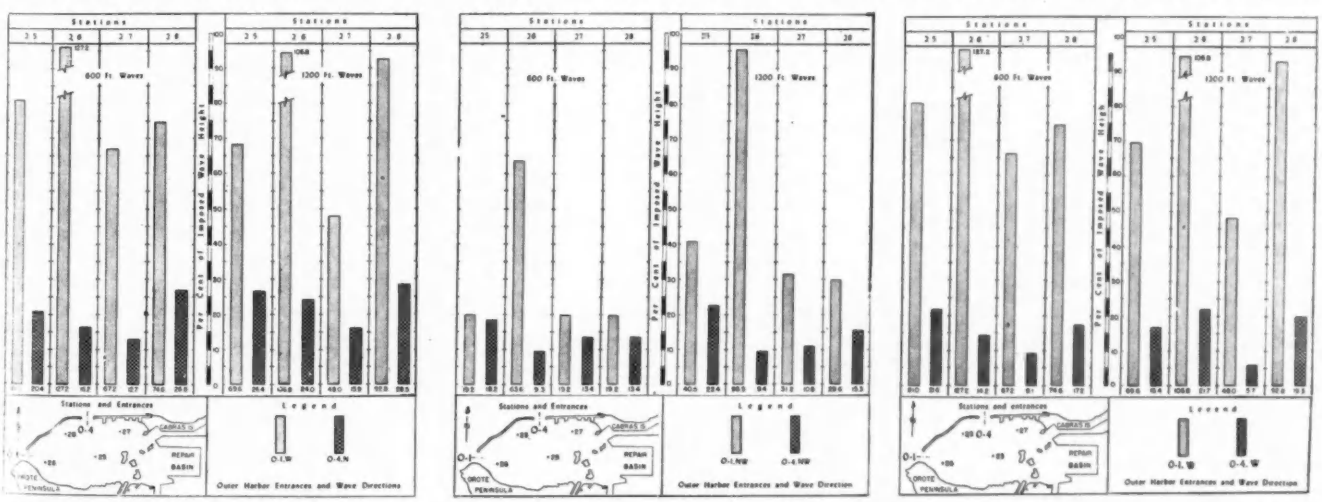



Fig. 33. Effect of entrances 0—1 and 0—4 on outer harbour. Waves from various directions (30-ft. high, 600 and 1,200-ft. long M.H.H.W.).

## *Model Studies of Apra Harbour—continued*

figures for the entrance 0-1 showed that the disturbances produced by waves from the most frequent direction (N.W.) are the following fractions of the disturbances produced by waves from the direction of greater intensity (W.):

(1) One half in the outer harbour.

(2) One third in the repair basin.

(3) One third along the east shore of the repair basin.

(4) One half at the south-west end of Army Port Facilities.

Similarly with the entrance 0-4, cut through the Luminao reef, the waves from the direction of greater intensity (W.) and the most frequent (N.W.) are the following fraction of disturbances produced by waves from the geometrically most direct direction (N.) for entrance 0-4:

(1) Three quarters (W.) and two thirds (N.W.) for outer harbour.

(2) One third (W.) and one half (N.W.) for the repair basin.

(3) One third (W.) and two thirds (N.W.) along the east shore of the repair basin; and

(4) One half (W.) and three quarters (N.W.) at the south-west end of Army Port Facilities.

The outstanding feature of this comparison is that for the existing entrance 0-1, a shift in wave direction of 45 degrees from the most severe to the more frequent, results in substantial reductions of disturbances in all areas within the harbour, whereas for the entrance 0-4 a similar shift from the northerly to the north-westerly results in little change in the disturbance within the harbour. This difference in behaviour is due to the long uniform and relatively shallow channel forming the entrance, in which there is sufficient distance for waves approaching from the north-west to be turned by the process of refraction and so approach the entrance that a crest of the full gate width is admitted (Fig. 31). The great depth and short channel of the actual entrance 0-1 does not favour refraction and therefore the north-west waves are not fully turned in. In this connection, however, it should be noted that had the actual entrance been located in the position 0-4, the westerly head would undoubtedly have been more to sea-ward, than shown in Fig. 30, to provide a screen to the east head; in other words, the west arm of the breakwater would have been re-aligned in an E.N.E. orientation and not E. to W., as in the tests.

These test runs for the different positions of entrances unmistakably showed the benefits to be derived by locating the harbour entrance to obtain a maximum expansion, or diffraction, of the waves. The disturbances arising from the entrance 0-4 were only 35 per cent. of those from the existing entrance 0-1, and in the areas of harbour usage only 18 per cent. R.R.M.

*(To be continued)*

# Shipping Matters Pertaining to Welsh Ports

## Speech Delivered before Industrial Association of Wales and Monmouthshire

At a Convention of the Industrial Association of Wales and Monmouthshire, held at Porthcawl towards the end of April last, Mr. L. G. Taylor (Assistant Chief Docks Manager, Docks & Inland Waterways Executive, South Wales Ports), who was the principal speaker, gave an interesting address on " Shipping and Matters pertaining to Welsh Ports."

### REVIEW OF AMERICAN METHODS

In his opening remarks, Mr. Taylor referred to his visit to the U.S.A. during the summer of 1950 and outlined the many differences between the ports on the Atlantic seaboard of North America and those of this country. By reason of the almost negligible tidal range, the American authorities have not been obliged to build and maintain costly walled structures to hold up dock water above the height of the water in their tideways, and therefore there has been no need for expensive necessities such as locks and lock gates, as is the case in this country. The result is that there are no port owners or Port Authorities in the States in quite the same sense as there are in this country. Most American ports, Mr. Taylor explained, are built up of a series of piers built out into open water of river mouths, etc. These piers are owned largely by the Railway Companies of the U.S.A., of which there are some 600 now operating, about 130 of which are classed as main line railways; other piers are owned by commercial companies, whilst some are the property of the City or State; only a minority being owned by a Port Authority. It is common practice to lease piers to shipping lines and contractors, who themselves equip and operate the piers. The Port Authorities themselves own little or no port equipment; tugs, floating cranes, elevators, etc., being operated by contractors, and even the dredging of the actual approaches to berths, etc., is done by contractors employed by lessees of piers, etc.

Channel dredging in the States, Mr. Taylor explained, is a Federal charge against the country's revenue—the actual work being performed by the U.S. Army Engineering Corps. Whilst any attempt to obtain similar Government responsibility in this country would be unlikely to meet with much success, the adoption of such an arrangement would go a long way towards solving what is becoming an increasingly important problem in South Wales.

The almost complete lack of quayside cranes at American ports was another fundamental difference, the practice in the States being to rely almost entirely upon ships' gear for general cargo working.

The absence of any registration scheme for port transport workers, such as that which exists in this country, was another feature. All American ports seemed to have an abundance of labour seeking engagement, as for example in New York, where there were said to be 42,000 men available, while the average daily employment was around 25,000 men. There is no guaranteed wage beyond an hourly rate for a four-hour minimum period, and men are still selected by individual operators' representatives, as used to be done in this country before decasualisation.

Discipline was good and the extent to which overtime could be worked warranted special mention; Saturday afternoons and evenings being the only times the men would not work, except to finish a ship or deal with passengers' baggage. Another difference of particular interest was that the American ports and transport business generally seemed to have no use for piecework, the theory being that it tended to increase the risk of careless handling and consequent damage.

The speaker then referred to the extensive development of mechanisation in shore work in the U.S.A., but pointed out that mechanisation in ships' holds was no further advanced than in this country.

The existence in the U.S.A. of such a large number of railway companies, many of whom owned waterside premises, led to rate wars and preferential practices, but the position in this respect had been met to some extent by the Interstate Commerce Commission (I.C.C.)—a Federal body which had a large measure of control over all forms of transport. Business interests who felt they were being unfairly treated could bring their case before the I.C.C. with the knowledge that it would at least have an impartial hearing.

### SUGGESTED GROUPING OF SOUTH WALES PORTS

Turning to the activities of the Joint Ports Committee of the Association, Mr. Taylor pointed out that this Committee had recently co-operated with the National Council for Wales and Monmouthshire in relation to the trade of the South Wales ports. The Council, which had already been assured of the support of the Docks & Inland Waterways Executive, had only two days previously interviewed the Railway Executive with the object of ensuring, if possible, that preferential treatment, in relation to both rates and conditions, as it existed in the past, would have

## *Shipping Matters Pertaining to Welsh Ports—continued*

no part in the new rates structure which the Railways are required by law to introduce.

Apart from this scheme, Mr. Taylor continued, there were still years of work to be undertaken to carry through the next stages of the programme of the Joint Ports Committee, and in regard to the future he was sorry to see that during recent months there appeared to be a tendency to revert to individual and separate action by the major South Wales ports, rather than strengthening of the common bond, which was the principal reason for forming the Joint Ports Committee. Whilst appreciating that the Committee would meet with little success if it attempted to curtail individual port efforts to improve their own position in regard to day to day affairs, it was nevertheless essential that the ports should speak with one voice, for unity was vital when fighting for common principles, such as are involved in the f.o.b. problem of the South Wales ports.

Matters which would have to be watched, in addition to the Railway Charges Scheme, would be a Dock Charges Scheme which the Docks and Inland Waterways Executive are required by the Transport Act of 1947 to produce, and likewise in the case of the Road Haulage Executive.

The support of liner owners would also have to be sought by getting them to adopt a common practice in relation to the shore services included in their freight rates.

In conclusion, Mr. Taylor referred to the arrangement at Liverpool, for example, where shipowners can lease sheds to their own line in which they engage their own staff and establish their regular organisations. Envisaging the development of the general cargo trade of the local ports to an extent where traffic was offering so regularly that Liner Companies sought leased and preferential berths, Mr. Taylor gave it as his opinion that the only way in which the position could be fairly met would be by treating South Wales as a group and offering preferential berthing rights at any of the ports where suitable accommodation was available. To bring this about, three major things would be necessary: (i) the common acceptance of the principle by all ports; in other words Newport, Cardiff and Swansea in particular, would have to be prepared to sink their parochialism to the extent of making the individual name of their port secondary to the name of the group; (ii) common average rail, road and dock rates applicable to all the South Wales ports on traffic brought from emanating points outside a radius or a geographical boundary designating local from long distance carriage; and (iii) changed practice by shipowners, so that they had latitude under their Conference arrangements to load at any port in the South Wales group.

### PROBLEMS FACING WELSH PORTS

The Chairman thanked Mr. Taylor for his excellent paper, and whilst the views expressed were entirely personal, he felt sure everybody present would heed the note of warning given by the speaker.

Mr. Taylor then dealt with questions put forward and, in reply to points raised by Mr. F. C. Moon, stated the labour force available at the South Wales ports was not depreciating to any great extent. Individual port requirements were covered by the transfer of labour scheme, and the availability of labour was a matter upon which a perpetual watch was carefully kept. It should be appreciated, however, that since decasualisation labour forces had to be kept at a reasonably economic mean level and could not carry the large surplus numbers necessary to meet all peak requirements to anything like the extent which sometimes happened when men had no guaranteed wage arrangements. Furthermore, the peculiarities of shipping had to be acknowledged, and in this connection Mr. Taylor quoted instances of the average numbers of men disengaged per week at the South Wales Docks during the current year.

With regard to the alleged shortage of shed accommodation and the present position of the various post-war shed schemes, Mr. Taylor explained that regard had to be given to (a) the present and future levels of trade; (b) the national control on capital expenditure; (c) the present economic position of the ports; and (d) the degree of urgency of such schemes in the light of overall commitments of the British Transport Commission.

Dealing with the question of appropriated berths, Mr. Taylor stated this was quite different from leased berths, in which case the berth was in effect the property of the Shipping Company concerned, and would be arranged provided the berth was occupied regularly and there was a constant accumulation of cargo, whereas in the case of appropriated berths, if the shipowner was not occupying the berth, then the Port Authority naturally reserved the right to do so.

The last point of Mr. Moon's question—that in regard to channel dredging, particularly at Cardiff—was next dealt with, and Mr. Taylor stated this was a major problem, involving the Port Authority in very heavy expenditure, as indicated by the fact that they had, during the first quarter of this year, dredged from the Cardiff channel some 560,000 tons of mud. The heavy deposits brought down by the River Taff had been attributed to several causes, but the solution to the problem seemed to be the construction of suitable training walls, which would confine the river to a set course. The question of sharing the cost of such a scheme would have to be decided before any real progress could be made.

### HARTLEPOOLS DOCKS IMPROVEMENT SCHEME.

The British Transport Commission have approved a recommendation of the Docks and Inland Waterways Executive for the reconstruction of the lightening berth at the Old Harbour, Hartlepools Docks, at an estimated cost of £330,000. When completed, the scheme will provide modernised accommodation and facilities for the larger ships now being used for the conveyance of timber and iron ore—the two principal trades at Hartlepools Docks—and will facilitate the turn-round of the vessels.

### MANAGEMENT OF PLYMOUTH (MILLBAY) DOCKS.

As from May 21, 1951, the administration of Plymouth (Millbay) Docks was transferred from the Railway Executive to the Docks and Inland Waterways Executive. The docks will be placed under the management of Mr. R. P. Biddle, C.B.E., Docks and Marine Manager, Southampton, an arrangement that will facilitate the co-ordination of the services and facilities of the ports for ocean liner traffic, of which Mr. Biddle has had a long experience.

## APPOINTMENTS.

**THE BOARD OF TRUSTEES OF THE PORT OF ADEN** has a vacancy for a **CIVIL ENGINEER** to act as second assistant to the Chief Engineer. Age not more than 30 years. Applicants should be corporate members of the Institution of Civil Engineers, but consideration will be given to candidates who have passed Sections A and B of the Institution examination or who hold a degree exempting them therefrom. Previous experience of harbour work and mechanical training is desirable. Salary £900 per annum rising by increments of £30 to £1,250 per annum, plus a travelling allowance of £90 a year (deduction for income tax about £40 per annum). On joining voyage period will be paid at the half rate of the salary. Free unfurnished quarters; heavy furniture available at nominal rental. Free medical attention is provided for the Officer (but not hospital expenses) and a contributory medical benefit scheme covers dependents. Participation in Aden Port Trust Contributory Pensions Fund (contribution 8½% of salary) and Widows & Orphans Fund (5% salary) compulsory. Free first-class sea passages each way once during each tour for the Officer and his wife and children (not exceeding four). Minimum tour 18 months, maximum usually not more than 30 months. Seven days full pay leave is earned for each month of duty service. Successful candidate will be required to pass a simple examination in colloquial Arabic within 18 months from the date of arriving in Aden. Service will be probationary for the first six months. Application form obtainable from: Aden Port Trust, 1, Lygon Place, London, S.W.1.

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A. G. STEPHENSON,
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Harbour Office,
Southwick, Sussex.
1st June, 1951.

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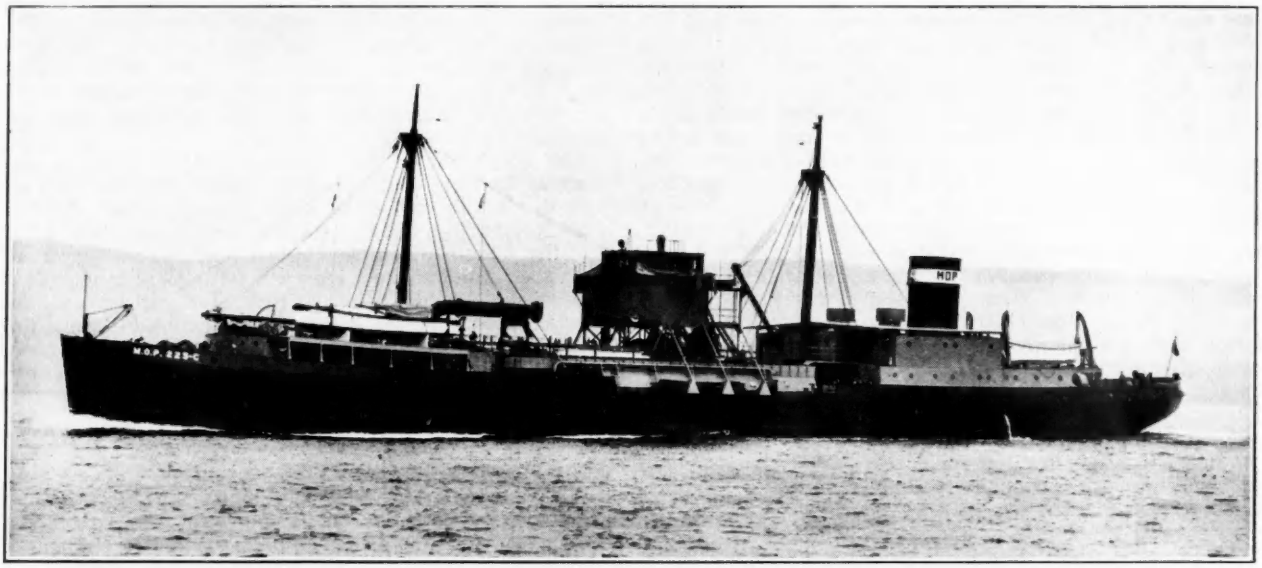

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